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Book of abstracts

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A Silicon Photomultiplier Camera for Use in the Cherenkov Telescope Array

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The Cherenkov Telescope Array (CTA) is the next-generation ground-based gamma-ray observatory sensitive in the energy regime of 30 GeV to 100 TeV. Telescopes with a novel Schwarzschild-Couder design are currently being developed as a contribution to CTA. Utilization of silicon photomultipliers (SiPMs) is being planned for use in the cameras of these novel telescopes. Silicon photomultipliers have advanced to a point where they not only compete with photomultiplier tubes, but can also outperform them. To understand the performance of a SiPM camera in CTA, we are working to understand the individual chips, the triggering of the camera, and the effect of the Schwarzschild-Couder design used in conjunction with SiPMs. We discuss the properties of the SiPM most important to the telescope performance and present the conceptual design of a camera for use in a prototype telescope under construction for first light in 2015.

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Tracker for the Mu2e Experiment at Fermilab

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The Mu2e experiment will search for neutrinoless conversion of muons to electrons using an intense muon beam stopped in an aluminum target. The signature is an electron with energy nearly equal to the muon mass. Precise and robust measurement of the outgoing electron momentum is an essential element to the experiment. We describe the design of a low mass tracking system to meet this requirement. The tracker must operate in a vacuum and a 1T magnetic field. We have chosen to use ~20K thin wall Mylar straws held under tension to avoid the need for supports within the active volume. In addition to measuring distance from the wire by drift time, sub nanosecond measurement of signal propagation time is used to measure position along the wire. Charge is measured using ADCs to provide particle identification capability. To minimize the number of vacuum penetrations, digitization is performed on the detector. Readout uses a triggerless, streaming architecture with data transmitted on optical fiber.

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Experimental progress on staged laser-plasma acceleration

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Laser-plasma accelerators (LPAs) [1] have produced GeV electron beams (e-beams) from cm-scale devices, demonstrating that LPAs have great potential for reducing accelerator size and cost [2]. LPA experiments performed to date utilize a single laser that drives the wakefield for injection and acceleration. For applications such as high-energy accelerators, LPA designs will rely on sequencing multiple acceleration stages, each driven by its own laser [3]. We present recent progress on the experiment staging two LPA modules at the LOASIS Program at Lawrence Berkeley National Laboratory. The experiment utilizes a 40 TW class laser which is split into two laser pulses. The first laser drives the first LPA module to produce an e-beam. The second laser drives the second LPA module and accelerates the e-beam from the first LPA. Excited wakefields in the second LPA module are diagnosed through spectral redshifting of the drive laser, which is an indicator of the efficiency of laser energy transfer into the plasma through the generation of coherent plasma wakefields [4].

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Experience Running an Analysis Cluster in an Academic Cloud

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Cloud computing offers the opportunity for small research groups with fluctuating computing needs to access significant computing power with minimal investment in hardware and administration. However the cloud environment presents its own challenges, in particular those posed by the movement and storage of the large datasets used in HEP. We have evaluated two academic Infrastructure as a Service cloud platforms (Nimbus and OpenStack) in the FutureGrid testbed at the Texas Advanced Computing Center. We report on the experience, in particular ease of use and performance.

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Intensity Frontier Computing at Fermilab

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The Intensity Frontier (IF) experiments at Fermilab require computing, software, data handling, and infrastructure development for detector and beamline design and to extract maximum scientific output from the data. The emphasis of computing at Fermilab for many years has been on the Tevatron collider Run 2 and CMS experiments. Using the knowledge and experience gained from those experiments as well as new computing developments, preparations for computing for IF experiments are ramping up.

There are many challenges in IF computing. These include event generators and detector simulation, beamline simulation, detector design and optimization, data acquisition, data handling, data analysis, and all of the associated services required. In this presentation many of these issues will be described, including a description of a new project, The Fabric for Frontier Experiments (FIFE), aimed at providing excellent modern computing services for the IF experiments at Fermilab.

FIFE is a collaborative effort between computing professionals and experiment scientists to produce an end-to-end, fully integrated set of services for computing on the grid and clouds, managing data, accessing databases, and collaborating within experiments. FIFE includes job submission services for processing physics tasks on the Open Science Grid and elsewhere, an extensive data management system, custom and generic database applications for calibrations, beam information, and other purposes and collaboration tools. FIFE sets the direction of computing at Fermilab experiments now and in the future, and therefore is a major driver in the design of computing services world wide.

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The new radiation-hard optical links for the ATLAS pixel detector

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The pixel detector of the ATLAS experiment is currently undergoing a major upgrade with the installation of a new layer of tracking and new service panels. As part of this upgrade an improved system of on-detector optical links is currently being installed in ATLAS. This new system incorporates lessons learned from the production and operation of the installed on-detector optical links resulting in improved reliability and flexibility. In this presentation the details of the implementation of this new design as well as results from radiation hardness studies and qualification studies will be discussed.

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Results from Step I of MICE and the Physics Plan for Step IV

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The Muon Ionisation Cooling Experiment (MICE) will demonstrate ionisation cooling, an essential technology for a
Neutrino Factory and/or Muon Collider, by measuring a 10% reduction in emittance of a muon beam. A realistic
demonstration requires beams closely resembling those expected at the front-end of a Neutrino Factory, i.e. with large
transverse emittance and momentum spreads. The MICE muon beam line at ISIS, RAL, was built to provide beams of
different momenta and emittance so that the performance of the cooling channel can be fully explored.
During the initial stage of MICE, a novel technique based on time-of-flight counters was used to establish that the beam
emittances are in the range 0.7--2.8 mm-rad, with central momenta from 170--280 MeV/c, and momentum spreads of about
20 MeV/c. These beams will be increased by means of scattering from high-Z material in the next stage of MICE and
measured using magnetic spectrometers. Finally, low-Z absorbers such as liquid hydrogen and LiH will be used to reduce
the emittance of the beam. The physics program of this step of MICE will be discussed, including all stages necessary for a
first demonstration of ionisation cooling.

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Radiation-Hard/High-Speed Parallel Optical Engine

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The LHC at CERN is now the highest energy and luminosity collider in the world. Upgrades to the accelerator are currently being planned to further increase the energy and luminosity. The detectors must be upgraded to take advantage of the planned accelerator upgrades. This requires the optical links to transmit data at much higher speed to handle the much increased luminosity. We will present the results from three R projects. The goal of the R is to develop an ASIC that contains an array of 12 high-speed drivers to operate an array of 12 VCSELs (Vertical Cavity Surface Emitting Lasers). With the spacing of 250 μm between two VCSELs, the width of an optical array is only 3 mm. High speed VCSEL arrays operating at 10 Gb/s are now readily available and have been proven to be radiation-hard in our previous studies. This allows the deployment of a compact 120 Gb/s parallel optical engines at a high radiation location close to the interaction region where space is at a premium.

We incorporate the experience gained from the fabrication and operation of the optical link system of the current ATLAS pixel detector into the design of the new ASICs. For the first R project, the ASIC is a 12-channel VCSEL array driver operating at 5 Gb/s per channel. Each channel has an LVDS receiver, an 8-bit DAC, and a VCSEL driver. The 8-bit DAC is used to set the VCSEL modulation current. There is also a single 8-bit DAC to set the bias currents of all channels simultaneously. A scheme for redundancy has also been implemented to allow bypassing of a broken VCSEL. To enable operation in case of a failure in the communication link to the ASIC, we have included a power on reset circuit that will set the ASICs to a default configuration with no signal steering and the VCSEL modulation current to 10 mA. The ASIC was designed using a 130 nm CMOS process to enhance the radiation-hardness. The performance of the fabricated ASIC at 5 Gb/s is satisfactory. We are able to program the bias and modulation currents and to bypass a broken VCSEL channel. The power-on reset circuits have been successfully implemented.

For the second R project, we modify the design of the ASIC to operate at 10 Gb/s. The 5 Gb/s VCSEL driver uses thick oxide transistors in order to provide sufficient voltage to drive the VCSEL. This is not practical for the high speed operation. We therefore modify the architecture to use thin oxide transistors and add a negative VCSEL bias voltage. We simulate the extracted layout with parasitic capacitance, inductance, and resistance from the VCSEL itself and the wire bonds and pads used for connecting the VCSEL to the ASIC. The simulated eye diagram is open, indicating that it is possible to design an ASIC to operate at 10 Gb/s using a 130 nm CMOS process.

For the third R project, we plan to export the design to a 65 nm CMOS process to further increase the operating margin at 10 Gb/s. This will allow us to compare this design to the 130 nm design which is not as expensive. We will present the preliminary results from this design.

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Data Driven Triggers for the NOvA Experiment

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The NOvA experiment has an 810 km long baseline and uses the upgraded NuMI neutrino beam from Fermi National Accelerator Laboratory to study neutrino oscillation parameters. The two fully active, functionally identical detectors are placed 14 milliradians off axis to access a narrow neutrino energy spectrum, due to the pion decay kinematics. The 300 ton near detector, located at Fermilab, is dwarfed by the 14 kton far detector at Ash River, MN and will be the largest free standing plastic structure in the world.

A data driven trigger framework has been developed to aid in achieving the physics goals of NOvA. It has been implemented as an alternative trigger path to the timing trigger of beam spills, as well as the gateway to explore physics unrelated to beam neutrinos. The data acquisition of the detector has a continuous readout enabling this trigger framework to record zero biased data. It has many commonalities to our analysis framework, handling the data stream in pseudo-real time, to ease the development by our collaborators. The status of several triggers as well as other proposed applications will be presented.

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Design considerations for the cosmic-ray-veto system of the Mu2e experiment at Fermilab

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Since the discovery of the muon, particle physicists have carried out a series of experiments aimed at measuring flavor violation in charged-lepton interactions. To date, no such violation has been observed. The Mu2e experiment at Fermilab will search for the charged-lepton-flavor-violating process of coherent muon-to-electron conversion in the presence of a nucleus with a sensitivity four orders of magnitude beyond current limits. The experiment will have a single event sensitivity of 2.3e-17 while limiting the total background to about half of an event. One potential background is due to cosmic-ray muons producing an electron that is indistinguishable from signal within the Mu2e apparatus. The cosmic-ray-veto system of the Mu2e experiment is tasked with vetoing cosmic-ray-induced backgrounds with high efficiency without inducing significant dead time and while operating in a high-intensity environment. In this talk some of the many challenges influencing the design of the cosmic-ray-veto system will be discussed.

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Silicon strip prototypes for the Phase-II upgrade of the ATLAS tracker for the HL-LHC

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This paper describes the integration structures for the silicon strips tracker of the ATLAS detector proposed for the Phase-II upgrade of the Large Hadron Collider (LHC), also referred to as High Luminosity LHC (HL-LHC). In this proposed detector Silicon strip sensors are arranged in highly modular structures, called "staves" and "petals". This paper presents performance results from the
latest prototype stave built at Berkeley. This new, double-sided prototype is composed of a specialized core structure, in which a shield-less bus tape is embedded in between carbon fiber lay-ups. The Electrical and thermal performance of the prototype is presented, as well as a description of the assembly procedures and tools.

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The MicroBooNE LArTPC

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MicroBooNE is a liquid argon time projection chamber scheduled to begin taking data in 2014 at Fermilab. While it will investigate physics objectives (cross sections, oscillations), it also has a role in the R effort for proposed larger LArTPCs. This talk will discuss the design of MicroBooNE detector and the status of construction.

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Scribe-Cleave-Passivate (SCP) Slim Edge Technology for Silicon Sensors

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We are pursuing a “slim edge” technology which allows a drastic reduction of inactive region along the perimeter of silicon detectors. Such reduction would benefit construction of large-area tracker and imaging systems. Key components of this method are surface scribing, cleaving, and passivation of the resulting sidewall. We will give an overview of the project, describe the on-going studies within frameworks of RD50 and ATLAS collaborations, and show recent progress. A particular emphasis will be given to device performance: charge collection near the edge and studies of radiation hardness of the slim edge technology.

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The ATLAS Diamond Beam Monitor

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The ATLAS Diamond Beam Monitor (DBM) is designed to measure the luminosity and provide important diagnostic information on the beam quality at the highest luminosity envisioned at the LHC. The DBM uses polycrystalline CVD diamond the same size and with the same pixel pattern as the Insertable B Layer (IBL) silicon sensors. The DBM consists of 8 telescopes with each telescope containing three planes of CVD diamond sensors. The telescopes are arranged in two groups of 4 at an eta of +/- 3.2 equally spaced in phi around the beam pipe. The DBM is currently under construction and its status as well as preliminary results from prototype DBM telescopes will be presented. This talk will also describe the lessons learned in constructing the DBM and the issues that should be addressed for future diamond based detectors.

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Wireless Power and Data Acquisition System for Large Instrumentation Systems

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In this talk, I will present the development of a new prototype wireless data acquisition system with the intended application to read-out
instrumentation systems having thousands of channels. The data acquisition and control is based on a compliant implementation of 802.11 based
hardware and protocols. Our case study is for large detectors containing photomultiplier tubes. We have explored both free-space optical and radio frequency options for wireless power transfer. The front-end circuitry, including a high-voltage power supply is powered wirelessly thus creating an all-wireless detector readout.
We have successfully tested the system as a single detector module that is power wirelessly and then sends data wirelessly. I will cover the performance of this all-wireless prototype system and how a large scale implementation of the system might be realized.

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A Convenient Method for Real Time Monitoring of Charged Particle Beam Profile and Fluence

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Systems of detectors installed at the LHC operate in the radiation field produced by LHC beam collisions. To measure the radiation damage of the components of the detector systems, prototype devices are irradiated at test beam facilities that reproduce the radiation conditions expected at the LHC. The profile of the test beam and the fluence applied per time must then be known. Techniques such as thin metal foil activation and radiographic image analysis have been used to measure these. However, these techniques typically do not operate in real time or else have large uncertainties; a new technique is necessary. We have developed a technique to monitor in real time the beam profile and fluence using an array of p-i-n semiconductor diodes whose forward voltage is linear with fluence over the fluence regime relevant to, for example, tracking in the LHC Upgrade era.

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Particle identification with the iTOP detector at Belle-II

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The Belle-II experiment and superKEKB accelerator will form a next generation B-factory at KEK, capable of running at an instantaneous luminosity 40 times higher than the Belle detector and KEKB. This will allow for the elucidation of many facets of the Standard Model by performing precision measurements of its parameters, and provide sensitivity to many rare decays that are currently inaccessible.
This will require major upgrades to both the accelerator and detector subsystems. The imaging Time-of-propagation (iTOP) detector will be a new subdetector of Belle-II that will perform an integral role in Particle identification (PID). It will comprise 16 modules between the tracking detectors and calorimeter; each module consisting of a quartz radiator, approximately 2.5m in length, instrumented with an array of 32 micro-channel plate photodetectors (MCP-PMTs).
The passage of charged particles through the quartz will produce a cone of Cherenkov photons that will propagate along the length of the quartz, and be detected by the MCP-PMTs. The excellent spatial, and timing resolution (of better than 50 picoseconds) of the iTOP system will provide superior particle identification capabilities, particularly allowing for enhanced discrimination between pions and kaons that will be essential for many of the key measurements to performed.
The status of the construction of the iTOP subdetector, and performance studies of prototypes at beam tests will be presented, together with prospects for physics measurements that will utilise the PID capabilities of the iTOP system.

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Ultra-Fast Silicon Detectors

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We propose to develop a fast, thin silicon sensor with gain capable to concurrently measure with high precision the space (~10 μm) and time (~10 ps) coordinates of a particle.
In collaboration with groups within RD50, we have measured charge multiplication with a gain of about 10, allowing to thin pixelated silicon sensors by at least a factor 10 by keeping the performance of thick sensors.
This will open up new application of silicon detector systems in many fields achieve four-dimensional high-precision measurements. We will discuss the basic sensor characteristics and the expected performance, the present status of sensors and readout electronics and discuss the required R topics.

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The LHCb upgrade

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The LHCb experiment is designed to perform high-precision measurements of CP violation and search for New Physics using the enormous flux of beauty and charmed hadrons produced at the LHC. The operation and the results obtained from the data collected in 2010 and 2011 demonstrate that the detector is robust and functioning very well. However, the limit of 1 fb−1 of data per nominal year cannot be overcome without improving the detector. We therefore plan for an upgraded spectrometer by 2018 with a 40 MHz readout and a much more flexible software-based triggering system that will increase the data rate as well as the efficiency specially in the hadronic channels. Here we present the LHCb detector upgrade plans, based on the Letter of Intent and Framework Technical Design Report.

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The LHCb trigger system: performance and outlook

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The LHCb experiment is a spectrometer dedicated to the study of heavy flavor at the LHC. The rate of proton-proton collisions at the LHC is 15 MHz, of which only 5 kHz can be written to storage for offline analysis. For this reason the LHCb data acquisition system -- trigger -- plays a key role in selecting signal events and rejecting background. In contrast to previous experiments at hadron colliders, the bulk of the LHCb trigger is implemented in software and deployed on a farm of 20k parallel processing nodes. This system, called the High Level Trigger (HLT) is responsible for reducing the rate from the maximum at which the detector can be read out, 1.1 MHz, to the 5 kHz which can be processed offline. The inherent flexibility of this software trigger allowed LHCb to run at twice its design instantaneous luminosity in 2012. Simultaneously, the HLT performed far beyond the nominal design in terms of signal efficiencies, in particular for charm physics. It also showcased a number of pioneering concepts, for example: the deployment of an inclusive multivariate B-hadron tagger as the main physics trigger of the experiment, buffering of events to local disks, and simulation-free event-by-event trigger efficiency corrections. This talk will cover the design and performance of the LHCb trigger system, and discuss planned improvements beyond LS1 as well as plans for the LHCb upgrade trigger.

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Potential Impact of a New GEM-Based Muon Detector on CMS Triggering

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Following the increases in the LHC instantaneous luminosity, maintaining effective triggering and avoiding dead time will become especially challenging. As the sensitivity of many physics studies, including higgs measurements, depends critically on the ability to maintain relatively low muon momentum thresholds, the identification of potential improvements in triggering is particularly important. We show that the addition of a new muon detector with high spatial resolution to the existing CMS muon system in the very forward region, where the background rates are especially high, allows for a substantial improvement in the performance of muon triggering. Integration of the new detector and the existing Cathode Strip Chamber system allows for a substantial improvement in muon trigger momentum resolution due to an increase in the lever arm for the measurement of the muon bending angle. We demonstrate that a detector based on triple GEM chambers is an excellent candidate for maintaining efficient muon triggering at CMS, owing to its high spatial precision and the ability to operate in the high rate environment of the very forward region.

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Cathode Strip Chamber upgrade for the CMS Endcap at the HL-LHC

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The High Luminosity LHC accelerator upgrade will provide five times higher instantaneous luminosity than the current LHC. This boost in luminosity will allow the Compact Muon Solenoid (CMS) experiment to probe the properties of the newly discovered Higgs boson and extend the search for new physics beyond the Standard Model. In order to handle the increased data rate and maintain high trigger efficiency for pseudorapidity up to 2.4, the readout and trigger electronics of the Cathode Strip Chamber (CSC) muon detectors in the CMS endcap are undergoing an upgrade. This talk will discuss the design of the new level-1 trigger electronics based on the new generation of FPGA technologies and fast optical links, the ongoing commissioning and system integration of new readout and trigger electronics for the ME1/1 system, as well as the results of testing for stability at high radiation levels expected in the HL-LHC environment. In conclusion, we will discuss plans for early commissioning of the system and the expected improvements in system performance.

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The Fast TracKer Upgrade to the ATLAS Detector

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When the LHC reaches beyond its current design luminosity, the load on the Level-2 trigger system will increase significantly due to both the need for more sophisticated
algorithms to suppress backgrounds and the larger event sizes. The Fast TracKer
(FTK) is a custom electronics system that will operate at the full Level-1
accepted rate of 100 KHz and provide high quality tracks at the beginning of
processing in the Level-2 trigger, by performing track reconstruction in hardware
with massive parallelism of associative memories (AM) and FPGAs.

The latest performance results in important physics for high luminosity LHC running
areas will be presented using data from the ATLAS
Monte Carlo simulation at different LHC luminosities. An overview of the system design and the status of R of individual components will be presented. Related technologies, such as AM chip and Advanced Telecommunications Computing Architecture (ATCA), will be discussed.

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Electrode Isolation on P-type Silicon Devices with Alumina (Al2O3) Passivation Layer

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Inter channel shortening due to electron accumulation layer near silicon surface is a problem for any segmented p-type and double-sided n-type detectors. The standard approach for inter-strip or inter-pixel isolation is an implanted p-type barrier, implemented as either p-stop or p-spray. We present an alternative approach to the isolation problem, which features alumina deposition as a top passivation layer. The alumina layer forms a negative interface charge with silicon surface that prevents formation of the electron accumulation layer. We test the method with conventional p-type sensors that do not have the p-type barrier between electrodes. The sensors have been reprocessed: the top side silicon oxide passivation is removed, and the alumina layer is deposited. Our measurements prove that the alumina layer provides the inter-electrode isolation.

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Alignment of CMS silicon pixel detector

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The silicon tracking system of CMS consists of 16588 modules, designed to precisely measure the trajectories of charged particles resulting from collisions at the LHC. The performance of the CMS tracker is dependent on the positional resolution of the modules with an accuracy on the order of microns, and thus requires that the alignment of the detector components be well measured. This is achieved through a track based alignment using the Millepede II program. In 2012, this included the measurement of alignment constants for large scale structures of the pixel detector on a run by run basis, to correct for large movements associated with magnet rampings and cooling failures.

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Studies of Beam Loss Effect on Silicon Strip Modules in ATLAS Detector

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We are investigating the effects that LHC beam loss would have on silicon strip modules in ATLAS detector. The beam loss would cause a large flux of charged particles to go through modules, on the order of 10^7 MIP per strip. There are several areas of concern regarding vulnerability of sensors and readout ASICs to the large charges. We will report on three studies tailored to different key components: a) study of punch-through structures designed to protect sensors, where the large particle flux was modeled with a laser pulse, b) study of ASIC susceptibility to the large charge pulses, c) SPICE modeling of the electric circuit including the relevant sensor and ASIC elements, as well as cables and power supplies. We will present conclusions regarding the module vulnerability to different beam loss scenarios.

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Proton-proton and electron-positron colliders in a 100 km ring at Fermilab

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Extending the energy frontier beyond the LHC would be vital to elucidate the nature of electroweak symmetry breaking and whatever new physics that might be found at the LHC. We propose here a proton-proton (pp) collider in a 100 km ring, with center of mass (CM) energy of ~100 TeV which would have substantial discovery potential for new heavy
particles and new physics beyond the Standard Model. In the case that LHC
experiments have already found exotic resonances or heavy "partner" particles,
this collider could fill out the "tower" of resonances (thus e.g. confirming an
extra dimension) or the full suite of partner particles (e.g. for
supersymmetry). The high luminosity of the new collider would enable unique
precision studies of the Higgs boson (including Higgs self coupling and rare
Higgs decays), and its higher energy would allow more complete measurements of
vector boson scattering to help elucidate electroweak symmetry breaking. We
also discuss an e+e- collider in the same 100 km ring with CM energies from 90
to 350 GeV, which would enable precision electroweak measurements up to
the ttbar threshold, and serve as a Higgs factory.

Cosmic Frontier / 210

The Cryogenic Dark Matter Search: Results and Prospects

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The Cryogenic Dark Matter Search is sensitive to WIMP interactions with target nuclei in germanium and silicon crystals held at ~50 mK. Detailed information contained in both phonon and ionization signals are used to create a WIMP-search region with backgrounds of less than one event. Raw data taken with the CDMS-II detectors was reprocessed with a pulse reconstruction algorithm which improves timing for energies near threshold. Blind analyses were then performed for the 612 kg-days of Ge exposure which yielded 2 WIMP candidate events in the 2009 analysis, as well as for 140 kg-days from eight Si detectors never before analyzed. Three WIMP-candidates were found in the Si data and new limits were extracted from the Ge data. The implications for low mass WIMPs, as well as results from the currently-running SuperCDMS experiment will be discussed.

Cosmic Frontier / 211

Reconstruction of Density field for Baryonic Acoustic Oscillations

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The dominant effect of the nonlinear evolution of the density field is the smoothing of the Baryonic Acoustic Oscillation (BAO) feature, the standard reconstruction technique has shown to reverse this smoothing recovering the linear density field. The standard reconstruction technique has been tested with simulations and very recently, it has been applied to SDSS galaxy data enabling a significative improvement in the precision of the BAO distance measurements.
We explore different methods to improve the standard reconstruction technique (Padmanabhan et al. 2012) and we tested with simulations and apply on SDSS-II/BOSS Data.

Cosmic Frontier / 218

The Dark Energy Survey Supernova Project

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The Dark Energy Survey (DES) is a five-year astronomical survey, starting in Fall 2013. DES is specifically designed to study dark energy, using a new 570-megapixel digital imager, the Dark Energy Camera, mounted on the Blanco 4-meter telescope at CTIO in Chile. It will do this using four major complimentary dark energy probes, one of which is Type Ia supernovae. As part of DES, a time-domain survey over 30 square degrees will yield well-measured light curves for approximately 4000 Type Ia supernovae, more than quadrupling the world's current cosmological sample. Extensive tests of the camera, operating systems, and data quality were carried out in a science verification observing period in 2012-13. I will present an overview of the DES supernova program and supernova results from the data taken during science verification.

Cosmic Frontier / 135

Kinetic Decoupling of Effective WIMPS

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I will present a calculation of the thermal decoupling temperature and implied dark matter halo mass distribution cutoff within the framework of effective theories of dark matter. For the first time, this calculation has been considered for all interactions which respect parity, whether the dark matter couples dominantly to leptons, quarks, or both, and including the relevant couplings to pions after the QCD phase transition and loop-induced couplings to leptons where they are not strongly suppressed. I will explore the implications of contact operator constraints for early universe cosmology, and find that, within effective theories of this type, there is no way to address the missing substructure problem by holding the dark matter in kinetic equilibrium sufficiently late in the universe.

Cosmic Frontier / 134

MS-DESI, a BAO Experiment to Study Dark Energy

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The mid-scale dark energy spectroscopic instrument (MS-DESI) is currently in conceptual design. MS-DESI will be an exceptionally powerful facility for the Cosmic Frontier research program, mapping the Universe in three dimensions by massively parallel measurements of galaxy redshifts. The experiment will be on sky by 2018 to study dark energy as a Stage-IV project exploiting the baryon acoustic oscillation (BAO) technique. This experiment will build upon the success of the BOSS experiment in demonstrating the power of BAO to study the expansion rate of the Universe. The large-scale structure of the Universe is a key prediction of cosmological models, and MS-DESI observations will allow us to probe diverse aspects of cosmology, from the nature of dark energy, to the neutrino mass hierarchy and absolute mass scale, to signatures of inflation.

Cosmic Frontier / 196

Searches for Dark Matter Annihilation in Dwarf Spheroidal Galaxies with the Fermi LAT

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The dwarf spheroidal satellite galaxies of the Milky Way are some of the most dark-matter-dominated objects observed. Their proximity, high dark matter content, and lack of astrophysical backgrounds make them one of the most promising targets for the indirect detection of dark matter via gamma rays. Here we report on gamma-ray observations of 25 Milky Way dwarf spheroidal satellite galaxies based on 4 years of Fermi Large Area Telescope (LAT) data. None of the galaxies are significantly detected in gamma rays. We utilize stellar kinematic data for a subset of 15 dwarf galaxies to place robust constraints on the thermally-averaged dark matter annihilation cross section in the dark matter mass range from 2 GeV to 10 TeV.

Cosmic Frontier / 191

DES Science Verification

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Starting this September the Dark Energy Survey collaboration will use 525 nights over five years with the Blanco 4-m telescope at CTIO to image 5000 square degrees of the sky in five optical filter bands. The primary science goal is to understand the properties of dark energy using four complementary techniques: galaxy cluster counts, weak lensing, angular power spectrum and type Ia supernovae. The combination of these methods will lead to significant improvements of the figure of merit defined by the Dark Energy Task Force.
The Dark Energy Camera, a new 570 megapixel CCD camera, was installed on the telescope August 2012 and on-sky commissioning took place in September and October. This was followed by an extensive science verification period that lasted until the end of the DES observing time in February 2013. The purpose of this effort was to establish that the instrument, telescope, and data handling systems were producing imaging data of sufficient quality to execute the Dark Energy Survey. An additional goal was to test and improve operational efficiency so that the DES collaboration can make optimal use of its allocated time once the survey starts. For a total of 23 nights and 57 half nights we operated DECam and collected imaging data to assess the delivered image quality, the photometric calibration, and the long term stability of key parameters such as the readout noise, gain and linearity. We will discuss the lessons learned during science verification and present initial results.

Cosmic Frontier / 190

Mass and light distributions of massive galaxy clusters with DECam

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DECam is the newly commissioned imager of the Dark Energy Survey (DES)with a very large Field-of-View (FoV) of more than 3 square degrees. During the DES science verification phase, we targeted four massive galaxy clusters visible from CTIO to measure their weak-lensing effect. We will present some of the first science-quality images from DECam and present the photometry and shape analysis that yielded mass and light maps of each system. Because of the large FoV, these maps allow us to determine the connection between mass and light on unprecedented scales.

Cosmic Frontier / 270

Complementarity and Searches for Dark Matter in the pMSSM

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The search for and identification of neutralino dark matter in supersymmetry requires a multi-pronged approach with important roles played by collider, direct and indirect dark matter detection experiments. We summarize the sensitivity of such searches at the LHC, combined with those by Fermi, CTA, IceCube/DeepCore, COUPP and XENON1T, to such particles within the context of the 19-parameter phenomenological MSSM.

Cosmic Frontier / 206

Using galaxies to understand weak lensing

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Weak lensing measurements are expected to be powerful probes of the physics of the dark sector. While the shear component of the lensing distortion has been detected and analyzed in several studies to date, the magnification component has received relatively little attention. We will show how an understanding of galaxy-scale physics can be used to dramatically improve both the systematic and statistical errors from forthcoming weak lensing measurements. We will show how combined shear and magnification measurements will permit substantial improvements in the constraints on dark energy physics achievable by surveys such as the Dark Energy Survey.

Cosmic Frontier / 145

Tests of Lorentz Invariance Violation with Gamma-rays

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Special and general relativity extended our understanding of the concepts of space and time, two of the most basic topics of investigation of modern physics. However, quantum theory has shown that there is more to learn regarding these concepts. Considerations of how to combine the concepts of quantum mechanics and gravity (quantum gravity) indicate that the Planck scale is a ``natural scale'' at which the physics of space-time predicted by relativity theory breaks down and thus requires modification, or a new paradigm. Gamma-ray observations of extraterrestial objects like gamma-ray bursts, active galactic nuclei, or pulsars with VERITAS, CTA, or HAWC could reveal effects that result from such a modification. An example that we will discuss in the context of ground based gamma-ray observatories is an energy dependent dispersion relation of the speed of light resulting from a violation of Lorentz invariance.

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Cerenkov Events Seen by The TALE Air Fluorescence Detector

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The Telescope Array Low-Energy Extension (TALE) is a hybrid, Air Fluorescence Detector (FD) / Scintillator Array, designed to study cosmic ray initiated showers at energies above ~3x10^16 eV. Located in the western Utah desert, the TALE FD is comprised of 10 telescopes which cover the elevation range 31-58 deg in addition to 14 telescopes with elevation coverage of 3-31 deg.
As with all other FD's, a subset of the shower events recorded by TALE are ones for which the Cerenkov light produced by the shower particles dominates the total observed light signal. In fact, for the telescopes with higher elevation coverage, low energy Cerenkov events form the vast majority of triggered cosmic ray events. In the typical FD data analysis procedure, this subset of events is discarded and only events for which the majority of signal photons come from air fluorescence are kept.
In this talk I will report on a study to reconstruct the "Cerenkov Events" seen by the high elevation viewing telescopes of TALE. Monte Carlo studies and a first look at real events seen by TALE look very promising. Even as a monocular detector, the geometrical reconstruction method employed in this analysis allows for a pointing accuracy on the order of a degree. Also, based on preliminary Monte Carlo studies, the expected energy resolution is better than 25%. Early indications are that it may be possible to extend the low energy reach of TALE to below 10^16 eV. This would be the first time a detector designed specifically as an air fluorescence detector is used as an imaging Cerenkov detector.

Cosmic Frontier / 179

The VERITAS Dark Matter Program: Status and Prospects

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In the cosmological paradigm, cold dark matter (DM) dominates the mass content of the Universe and is present at every scale. Candidates for DM include many extensions of the standard model, with a weakly interacting massive particle (WIMP) in the mass range from 50 GeV to greater than 10 TeV. The self-annihilation of WIMPs in astrophysical regions of high DM density can produce secondary particles including very high energy (VHE) gamma rays with energies up to the DM particle mass. VERITAS, an array of atmospheric Cherenkov telescopes, designed for the detection of VHE gamma rays in the 100 GeV-10 TeV energy range, is an appropriate instrument for the indirect detection of DM. Among the possible astrophysical objects considered to be candidates for indirect DM detection, VERITAS has focused on observations of dwarf spheroidal galaxies (dSphs) of the Local Group, the Galactic Center, Fermi-LAT unidentified GeV sources and the Local Group galaxy M31. This presentation reports on our extensive observations of these targets and our present exclusion regions obtained on the thermally averaged annihilation cross section of the WIMP derived from these observations.

Cosmic Frontier / 176

New results from SDSS-III BOSS: cosmic expansion and growth of structure

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The SDSS-III Baryon Oscillation Spectroscopic Survey, now 90% complete, is measuring the three-dimensional cosmic structure with 1.35 million new redshifts. Galaxy clustering measurements provide constraints on the cosmic expansion history through the baryon acoustic oscillation feature. In addition, the imprint of galaxy peculiar velocities on the observed galaxy clustering, "redshift-space distortions", provide a measurement of the growth rate of matter perturbations. Taken together, these measurements provide excellent constraints on dark energy and test the relation between expansion history and growth of perturbations expected in General Relativity. I will present an update from BOSS in the context of other recent results such as Planck.

Cosmic Frontier / 183

After LUX: The LZ Experiment

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The fundamental nature of dark matter is one of the key open questions that is currently being probed at underground sites worldwide. The LZ experiment is a next generation liquid Xenon detector that will continue this search, building upon the expertise and experience provided by the LUX experiment. The proposed LZ detector will be a 7-ton liquid Xe TPC that will use the current infrastructure for LUX at the Sanford Underground Research Facility (SURF) and will be installed once LUX has finished taking data. Using a fiducial mass of over 5-tonnes, the experiment can reach WIMP-nucleon cross sections down to 2×10^{-48} cm^2 in 3 years of operation.

Cosmic Frontier / 180

The Dark Energy Survey

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The Nobel Prize in Physics for 2011 was awarded for the discovery that the expansion of the Universe is accelerating. Yet the physical origin of cosmic acceleration remains a mystery. The Dark Energy Survey (DES) aims to address the questions: why is the expansion speeding up? Is cosmic acceleration due to dark energy or does it require a modification of General Relativity? If dark energy, is it the energy density of the vacuum (Einstein's cosmological constant) or something else? DES will address these questions by measuring the history of cosmic expansion and of the growth of structure through four complementary techniques: galaxy clusters, large-scale galaxy clustering, weak gravitational lensing, and supernovae. The DES collaboration has built a new, 570-megapixel, digital camera for the Blanco 4-meter telescope at Cerro Tololo Inter-American Observatory in Chile to carry out a deep, wide-area sky survey of 300 million galaxies and a narrower, time-domain survey that will discover 4000 supernovae over 525 nights starting in Sept. 2013. This talk will overview the DES project, which achieved `first light' in September 2012, describe early science results from commissioning and science verification of the instrument, and discuss the plans and goals of the survey.

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Particle Acceleration in Relativistic Jets: Results from VERITAS

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Relativistic jets are extremely powerful outflows of collimated plasma that may be seen in active galactic nuclei (AGN), gamma-ray bursts, and X-ray binaries. AGN are believed to be powered by the accretion of matter onto a super-massive black hole (SMBH). The observed similarities (in morphology and spectrum) of jets from black holes of different masses suggests that they share a common physical origin. Very-high-energy (VHE; E > 100 GeV) gamma-ray emission has been measured for more than 50 active galactic nuclei out to distances of at least 7.4 billion light-years (red shifts > 0.6035). Observations of astrophysical objects in the TeV band are sensitive probes of highly energetic processes occurring in these sources. The detection of > 10 TeV gamma-rays from AGN demonstrates that they accelerate particles up to extreme energies, which makes them natural candidates to explain the origin of ultra-high-energy cosmic rays (E > 10^18 eV). The majority of the active galaxies detected at TeV energies are blazars, sources where the jet is viewed nearly along its axis. Outstanding questions in TeV astrophysics of blazars include the nature of the jet structure, formation, acceleration and collimation, as well as the particle content of jets. Blazars are also the best probes of the extragalactic background light via the pair production of TeV photons traveling cosmological distances, and blazar observations may also be used to constrain intergalactic magnetic fields. In this talk we will summarize recent results from the VERITAS imaging atmospheric Cherenkov telescope on observations of VHE emission in the 100 GeV-20 TeV band from blazars and X-ray binaries, and discuss the results in the context of particle acceleration in jets.

Cosmic Frontier / 184

Fermi-LAT observations of diffuse gamma-ray emission

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Cosmic rays are a probe of the most energetic processes in the Universe and may encode signatures of dark-matter particles annihilation or decay. The Large Area Telescope on board the Fermi Gamma-ray Space Telescope indirectly traces cosmic rays throughout the Galaxy thanks to the diffuse gamma-ray emission produced by inelastic collisions of cosmic-ray nuclei with interstellar gas and by electrons and positrons that undergo bremsstrahlung or inverse-Compton scattering. I will review the main results from Fermi in the field with focus on the uncertainties of the backgrounds for dark-matter searches.

Cosmic Frontier / 312

Non-Thermal Production of Dark Matter as Dark Radiation

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The Planck and WMAP9 satellites, as well as the ATACAMA and South Pole telescopes, have recently presented results on the angular power spectrum of the comic microwave background. Data tentatively point to the existence of an extra radiation component in the early universe. Here, we show that this extra component can be mimicked by dark matter particles whose majority is cold, but with a small fraction being non-thermally produced in a relativistic state. We present a supersymmetric example where this scenario is explicitly
realized, and explore the relevant parameter space consistent with BBN, CMB and Structure Formation bounds.

Cosmic Frontier / 188

Searching for Q-balls with the High Altitude Water Cherenkov Observatory

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The High Altitude Water Cherenkov (HAWC) Observatory is a gamma-ray experiment currently under construction at Sierra Negra in Mexico. When complete it will consist of a 22,000 square meter array of 300 water Cherenkov detectors. Although HAWC is designed to study gamma rays from galactic and extra-galactic sources, the large volume of instrumented water (each tank holds ~188,000 liters) gives the opportunity to search for rare objects. One such relic from the early universe are Q-balls, which are naturally produced by the Affleck-Dine mechanism during the inflationary epoch. Q-balls are very massive, subrelativistic particles that can have a large baryon number and can be stable since their creation in the early universe. They are an appealing candidate for the dark matter of the universe, but their large mass means their flux is very low. HAWC has a flexible data acquisition system which, with a dedicated trigger algorithm for non-relativistic species, allows a search for Q-balls traversing the detector. The trigger algorithm, expected sensitivity, and preliminary analysis will be presented.

Cosmic Frontier / 167

Indirect Dark Matter Searches with the Cherenkov Telescope Array

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A leading candidate for astrophysical dark matter (DM) is a weakly interacting particle with a mass in the range from 10 GeV to 10 TeV. The pair annihilation of DM in environments with high DM density such as in the cores of galaxies could produce gamma-ray signals detectable with space- or ground-based gamma-ray observatories. The Cherenkov Telescope Array (CTA) is a future ground-based gamma-ray observatory that will be sensitive to gamma rays in the energy range from a few tens of GeV to 100 TeV. I will present the projected sensitivity of CTA to DM signals in the Galactic Center region and dwarf spheroidal galaxies of the Milky Way. I will discuss these projections in the context of a specific model framework, the phenomenological MSSM (pMSSM), and review the complementarity of CTA with direct detection experiments and DM searches at the Large Hadron Collider.

Cosmic Frontier / 163

Prospects for Fundamental Physics and Cosmology with the Cherenkov Telescope Array

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The Cherenkov Telescope Array (CTA) will be a new observatory for the study of very high energy (VHE) gamma-ray sources. It is designed to achieve an order of magnitude improvement in sensitivity in the ~30 GeV to ~100 TeV energy band compared to currently operating instruments (VERITAS, MAGIC, HESS). The design and capabilities of CTA will be described. The presentation focuses on how CTA will be able to address key topics in fundamental physics and cosmology. Principal among these is the search for cosmic signals of dark matter annihilation, and it will be described how CTA is sensitive to higher dark matter particle masses which are complementary to the expected results from Fermi-LAT and difficult to probe with direct detection and LHC experiments. Studies of the extragalactic background light and intergalactic magnetic fields with CTA will be important tests of cosmological models. Searches for Lorentz invariance violation and photon mixing with axion-like particles will probe physics beyond the Standard Model.

Cosmic Frontier / 48

Cosmology with galaxy clusters in DES

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Galaxy clusters are one of the four key cosmic acceleration probes used by the Dark Energy Survey (DES) to measure cosmological parameters with unprecedented precision. DES has recently completed commissioning of its instrument and accomplished a successful science verification data taking phase. The survey proper will soon begin. In this talk, I review the motivation for using clusters of galaxies in cosmology, discuss the DES expected performance and present the prospects to improve our understanding of dark energy by constraining cosmological models.

Cosmic Frontier / 203

Photometric Redshift Calibration of the Dark Energy Survey

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During fall 2012 the Dark Energy Survey (DES) collaboration installed and commissioned DECam, a 570 mega-pixel optical and near-infrared camera with a large 3 sq. deg. field of view, set at the prime focus of the 4-meter Blanco telescope in CTIO, Chile. In the course of the next five years DECam will map an entire octant of the southern sky to unprecedented depth, measuring the position on the sky, photometric redshift (photo-z) and shape of over 200 million galaxies, together with thousands of galaxy clusters and supernovae. With this data set, DES will study the properties of dark energy using four main probes: galaxy clustering on large scales, weak gravitational lensing, galaxy-cluster abundance, and supernova distances.

A "Science Verification" (SV) period of observations, lasting until late February 2013, followed the DECam commissioning phase, and provided science-quality images for about 150 sq. deg. at the nominal depth of the survey. During the SV period, four ~1 sq. deg. fields with extensive spectroscopic coverage were observed, resulting in close to a million galaxies with DECam 5-band photometry, with over 15,000 of them having secure spectroscopical redshift information. This sample has been used to characterize the precision of several photo-z algorithms, also providing estimates for the true spectroscopic redshift distribution in several photo-z bins, which is needed for galaxy clustering and weak lensing tomographic studies in the main DES-SV galaxy sample. The talk will present the result using the current four photo-z calibration fields, and will summarize the plans and prospects for the photo-z calibration of the whole DES survey.

Cosmic Frontier / 75

On a singular solution in Higgs field (6) – A long time behavior of the candidate for dark energy

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A long time behavior of the candidate for dark energy which satisfies the latest result of WMAP (9 Years: $\Omega\Lambda=0.721\pm0.025$) and is considered as one of the degenerates 1) of ur-Higgs boson which has appeared as a mother for SM Higgs boson 2), is studied. It is shown that such a dark energy of almost non-mass fullerene will disrupt gradually into smaller ones consist of several σ mesons by collisions with another fullerene, which have also a fewer ω mesons inside than before collision. Then it could be expected that the working force to expand the volume of universe is thought to be the result of these fullerenes' mutual repulsive strong force between respective ω mesons, which will rise as soon as they (smaller fullerenes) approach very near each other. Where we regard the fullerene as a finite nucleus of the limit of $m(p, n)\rightarrow 0$ in mean-field Dirac equation with σ-ω model. Hence by schematically describing a detailed disruption-behavior in long time of the non-mass fullerene, we try to explain the observed accelerating expansion of the universe with the scale factor (a) in Robertson-Walker metric. It is noted that the accelerating expansion will continue until number of ω meson in the disrupted fullerene becomes around one or zero; then the expansion slows down and at last the contraction of universe begins after equilibrium by central gravity which may feel effective mass of σ potential, with some quasi-static clustering of the disrupted fullerenes under attractive force between their σ mesons.

1) K.K., EPS HEP 2013 (to be presented).
2) K.K., 51st BORMIO Meeting 2013; to be, PoS(Bormio 2013)008.

Cosmic Frontier / 144

Constraints on Dark Matter Annihilation in Clusters of Galaxies from Diffuse Radio Emission

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Annihilation of dark matter can result in the production of stable Standard Model particles including electrons and positrons that, in the presence of magnetic fields, lose energy via synchrotron radiation, observable as radio emission. Galaxy clusters are excellent targets to search for or to constrain the rate of dark matter annihilation, as they are both massive and dark matter dominated. We place limits on dark matter annihilation in a sample of nearby clusters using upper limits on the diffuse radio emission, low levels of observed diffuse emission, or detections of radio mini-haloes. We find that the strongest limits on the annihilation cross section are better than limits derived from the non-detection of clusters in the gamma-ray band by a factor of about 3 or more when the same annihilation channel and subtructure model, but different best-case clusters, are compared. We discuss uncertainties due to the limited available data on the magnetic field structure of individual clusters.

Discussion on gender bias in physics / 309

Gender Bias in Physics

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Electroweak Physics / 133

Production Cross Section Measurements of Diboson and Triboson Containing W Bosons at ATLAS, LHC

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The production cross section measurements of dibosons and tribosons with W bosons using approximately 20 inverse femtobarn data of 8 TeV p-p collisions collected by the ATLAS detector at the Large Hadron Collider are presented. These measurements are important tests of the Standard Model predictions. The final states of interest include WW, WZ, Wgamma and Wgammagamma. No significant deviations from the SM expectations are observed and the limits on the anomalous gauge boson couplings are derived.

Electroweak Physics / 58

Measurements of vector boson production in association with jets in ATLAS

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A measurement of vector boson production and the ratio of W boson
to Z boson production in association with jets using sqrt(s) = 7 TeV
p-p collisions at the LHC of the 2011 ATLAS dataset with an
integrated luminosity of 4.6 pb is presented. Inclusive and
differential cross sections and cross section ratios for the vector bosons decaying to electrons and muons are measured for jets with transverse momentum pT > 30 GeV and jet rapidity |y| < 4.4.
The measurements are compared to next-to-leading-order perturbative
QCD calculations, and to predictions from different Monte Carlo generators implementing leading order matrix elements supplemented
by parton showers.

Electroweak Physics / 292

Theory of anomalous gauge boson couplings

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TBD

Electroweak Physics / 241

Measurement of the ZZ production cross section and search for the standard model Higgs boson in the four lepton final state

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Due to its small branching ratio, the process $p\bar{p} \longrightarrow Z/\gamma^* Z/\gamma^* \longrightarrow l^+l^-l'^+l'^-$ has one the smallest cross sections in the Standard Model (SM). However, the presence of four isolated leptons in the final state makes this process a very pure one, with a relatively small background. In this work we present a measurement of the cross section $p\bar{p} \longrightarrow Z/\gamma^* Z/\gamma^* \longrightarrow l^+l^-l'^+l'^-$ with up to 9.8 fb^{-1} of data collected with the D0 detector between 2001 and 2011. We also perform a search for SM Higgs boson studying the process $gg \longrightarrow H \longrightarrow ZZ \longrightarrow l^+l^-l'^+l'^-$ and the ZH associated production where $H \longrightarrow \tau\tau \longrightarrow l\nu\nu l\nu\nu$, $H \longrightarrow WW \longrightarrow l\nu l\nu$, and $H \longrightarrow ZZ$ where at least one of the Z bosons decays leptonically.

Electroweak Physics / 240

Measurements of the W boson mass with the D0 detector

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We present a measurement of the W boson mass using data corresponding to an integrated luminosity of 4.3 fb-1 collected with the D0 detector during Run 2 at the Fermilab Tevatron ppbar collider. With a sample of 1,677,394 W--> e nu candidate events, we measure M_W = 80.367 +/- 0.026 GeV. This result is combined with an earlier D0 result determined using an independent Run 2 data sample, corresponding to 1 fb-1 of integrated luminosity, to yield M_W=80.375+/-0.023 GeV.

Electroweak Physics / 104

Electro-weak Bound States

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Beginning with the electroweak Lagrangian, the the two-body Green's function can be written for various two body systems. For each possible two body system, the appro- priate Bethe-Salpeter equation is derived from which bound states containing any of the particles that are the constituents of the electro-weak theory. In particular, bound states with vector bosons is constituent are described as vector boson-anti-vector bo- son, etc . The perturbation theory is developed so that one can calculate the energy levels as precisely as desired. Furthermore, discussion of how to obtain the Bethe- Salpeter equation for any spin particles in general, is also discussed . Lowest-order corrections for the electro-weak bound systems is calculated as well.

Electroweak Physics / 66

Search for anomalous gauge couplings in semi-leptonic decays of WWγ and WZγ in pp collisions at $\sqrt{s}$ = 8 TeV

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A study of the Standard Model (SM) three electroweak boson production, WVγ where V = W or Z gauge boson, is presented concerning events with a leptonically decaying W boson accompanied by a photon and two or more jets. We are using the full 2012 dataset, of proton-proton collisions at a center-of-mass energy of 8 TeV and an integrated luminosity of 20 fb^{-1}, collected by the CMS detector at the Large Hadron Collider (LHC). WVγ production final states may be sensitive to anomalous WW$\gamma\gamma$ and WWZγ quartic couplings. In light of the recent discovery of a Higgs-like particle, we investigate, in a model independent way, any deviation of gauge boson couplings with respect to the SM prediction by setting limits on the anomalous quartic gauge couplings (aQGC) for WW$\gamma\gamma$ and WWZγ. Upper limits at 95\% confidence level are obtained, with and without a form factor.

Electroweak Physics / 143

Measurements of VV Boson Production And Self-Interactions in The Semileptonic Channel at CMS

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We present a summary of the latest measurements of the VV cross-sections, where V=W or Z and one of the bosons decays into a pair of jets while the other decays leptonically. The data sample(s) correspond to proton-proton collision events collected with the CMS detector at sqrt(s) = 7, 8 TeV. Subsequent searches for Anomalous Triple Gauge couplings, which allow us to probe the non-Abelian structure in the Electroweak Sector, are described. We present the exclusion limits on the corresponding couplings.

Electroweak Physics / 90

Measurements of ZZ, Zγ, and Zγγ production at the LHC with ATLAS

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Measurements of the productions of final states with multiple neutral bosons with ATLAS will be reported. Using 20 fb−1 data collected by the ATLAS detector at a center-of-mass energy of 8 TeV of proton-proton collisions, the production cross sections for ZZ, Zγ and Zγγ final states are measured using events where the Z bosons decay to electron- or muon- pairs. These final states have clean experimental signatures and low back- grounds which make them ideal for precise tests of the Standard Model and for searches of new physics through the anomalous coupling measure- ments. The neutral diboson final states are important for newly discovered Higgs boson measurements as well as for new resonance searches at the LHC.

Electroweak Symmetry Breaking and the Higgs Sector / 217

Vector boson fusion Higgs production in H\rightarrow{WW}\rightarrow{l \nu l \nu} in ATLAS

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With the discovery of the Standard-Model-like Higgs boson in the summer of 2012, experimental focus has shifted to the measurement of its properties. Higgs boson production via a vector boson fusion (VBF) process is a direct consequence of the Higgs mechanism of electroweak symmetry breaking. This process is directly sensitive to the coupling of the Higgs boson to the weak vector gauge bosons. The contribution will summarize latest ATLAS results for the VBF Higgs production in the H->WW decay mode. The analysis uses proton-proton collision data corresponding to 4.6 fb-1 of data at sqrt(s) = 7 TeV and 20.7 fb-1 of data at sqrt(s) = 8 TeV recorded by the ATLAS detector. This presentation will focus on analysis techniques and statistical interpretation of the observed data.

Electroweak Symmetry Breaking and the Higgs Sector / 289

Implications of a 125 GeV SM-like Higgs

Dr. DRAPER, Patrick [1]

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I will survey some of the theoretical implications of a Higgs boson with the observed mass and couplings, focusing on the Standard Model, supersymmetry, and two-Higgs doublet models.

Electroweak Symmetry Breaking and the Higgs Sector / 287

Electroweak Baryogenesis and Higgs Signatures

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We explore the connection between the strength of the electroweak phase transition and the properties of the Higgs boson. Our interest is in regions of parameter space that can realize electroweak baryogenesis. We do so in a simplified framework in which a single Higgs field couples to new scalar fields charged under SU(3)_c by way of the Higgs portal. Such new scalars can make the electroweak phase transition more strongly first-order, while contributing to the effective Higgs boson couplings to gluons and photons through loop effects. For Higgs boson masses in the range 115 GeV < m_h < 130 GeV, whenever the phase transition becomes strong enough for successful electroweak baryogenesis, we find that Higgs boson properties are modified by an amount observable by the LHC. We also discuss the baryogenesis window of the minimal supersymmetric standard model (MSSM), which appears to be under tension. Furthermore, we argue that the discovery of a Higgs boson with standard model-like couplings to gluons and photons will rule out electroweak baryogenesis in the MSSM.

Electroweak Symmetry Breaking and the Higgs Sector / 129

Higgs to WW production at ATLAS

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In the summer of 2012, the ATLAS and CMS collaborations announced a discovery of the Standard-Model-like (SM) Higgs boson. Experimental focus has now shifted to precision measurements of properties of the new particle, such as couplings and spin. The SM Higgs boson is primarily produced via gluon fusion (GGF) and vector boson fusion (VBF) processes. This contribution will summarize latest ATLAS measurements of the Higgs boson properties in the H->WW decay mode, focusing on analysis channels most sensitive to the GGF production. The analysis uses proton-proton collision data corresponding to 4.6 fb-1 of data at sqrt(s) = 7 TeV and 20.7 fb-1 of data at sqrt(s) = 8 TeV recorded by the ATLAS detector. This presentation will focus on analysis techniques, data driven background estimation methods, and statistical interpretation of the observed data.

Electroweak Symmetry Breaking and the Higgs Sector / 69

Search for invisible decays of a Higgs boson produced in association with a Z boson in ATLAS

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Various extensions of Standard Model predict possible decays to invisible particles of the Higgs boson recently discovered at the Large Hadron Collider. This presentation will report results of a direct search for invisible decays of Standard Model-like Higgs boson which is produced in association with a Z boson, using the 4.7 fb-1 of data at sqrt(s) = 7TeV and 20.3fb-1 of data at sqrt(S) = 8 TeV recorded by the ATLAS detector. This contribution will report ATLAS limits on the branching fraction for the Higgs boson decays to invisible particles at m_{H} = 125 GeV. Limits will be also presented for the cross section times the branching fraction of a possible additional Higgs-like boson decaying to invisible particles over the mass range 115 GeV < mH < 300 GeV.

Electroweak Symmetry Breaking and the Higgs Sector / 198

ATLAS Searches for BSM Higgs Bosons

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The status of ATLAS searches for Higgs bosons in extensions of the Standard Model is presented. The results cover in particular searches for the Higgs bosons of the Two Higgs Doublet Model (2HDM), the Minimal Supersymmetric Model (MSSM) and the Next to Minimal Supersymmetric Model (NMSSM). A review of the phenomenology of the Higgs sectors of these models will be given together with experimental results from ATLAS.

Electroweak Symmetry Breaking and the Higgs Sector / 80

Search for the SM Higgs Boson Produced in Association with a Vector Boson and Decaying to Bottom Quarks

Mr. MOONEY, Michael [1]

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A search for the Higgs boson produced in association with a W or Z boson and decaying to bottom quarks is presented. A sample of approximately 24/fb of data recorded by the CMS experiment at the Large Hadron Collider, operating at center-of-mass energies of 7 TeV and 8 TeV in 2011 and 2012, respectively, is used to search for events consistent with the signature of two b-jets recoiling with high momentum from a W(lnu), Z(ll), or Z(nunu) decay, where l = electron or muon (or hadronically-decaying tau particle in the case of W bosons). Observed signal significance and 95% confidence level upper limits on the production cross-section relative to the Standard Model prediction are presented for the 110-150 GeV Higgs mass range.

Electroweak Symmetry Breaking and the Higgs Sector / 307

Search for invisible Higgs decays at CMS

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This talk presents the CMS results on the search for a Higgs signal that decays to undetected particles. The particular signal of interest is a Z boson, decaying into charged leptons, produced in conjunction with an invisibly decaying Higgs boson. This search utilizes techniques of the measurement of the ZZ production cross section, where one Z decays into neutrinos and the other into charged leptons. This ZZ mode is an irreducible background to the invisible Higgs search, and the ZZ measurement results are discussed as well. This search uses the full LHC dataset of pp collisions at energies 7 and 8 TeV.

Electroweak Symmetry Breaking and the Higgs Sector / 247

Properties of a Higgs-like particle of mass 125 GeV

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We report the latest results from Higgs Boson studies at the D0 detector. We will place particular emphasis on measurements of Higgs properties, particularly spin and parity studies in bbbar final states, but also including cross sections and branching fractions in a wide range of possible Higgs production and decay modes.

Electroweak Symmetry Breaking and the Higgs Sector / 109

Searches for low-mass Higgs at BaBar

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Searches for low mass CP-odd Higgs boson (A0) predicted in non-minimal supersymmetric extensions of the Standard Model, have been performed at BaBar by studying the radiative decays of the Y(nS) resonances, with n=1,2,3. Stringent limits on the production of a light Higgs boson have been set.

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Search for Non-Standard-Model Higgs Boson Decays Using Collimated Muon Pairs at the CMS

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Direct searches for non-SM decays of a Higgs boson provide an alternative and possibly faster path to understanding the nature of newly discovered Higgs-like particle by either confirming or restricting a wide range of scenarios beyond the SM. We present a search for non-SM Higgs boson decays to a pair of new light bosons, each of which subsequently decays into a collimated pair of muons. The search is performed using data collected by the CMS experiment. Results are interpreted in a model independent fashion applicable to a broad class of models predicting same signature. Two benchmark scenarios are also considered: the Supersymmetry with dark sector (dark SUSY) which includes light dark photons and the Next-to-Minimal Supersymmetric Standard Model (NMSSM) which predicts the CP-even Higgs bosons decay to a pair of light CP-odd Higgs bosons.

Electroweak Symmetry Breaking and the Higgs Sector / 288

Searching for neutral Higgs bosons in non-standard channels

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In a variety of well motivated models, such as two Higgs Doublet Models (2HDMs) and supersymmetric extensions of the Standard Model (SSM), there are additional neutral Higgs bosons. The $\tau \tau$ channel is the preferred mode for discovering such scalars at the LHC. However many of these models can have a suppressed $\tau \tau$ coupling and hence alternative discovery modes are required. In this talk, I will discuss two possible modes for searching for such neutral scalars. I will discuss the prospects of observing such scalars in the 3b and $H\to Z A$ channels at the LHC and compare our projections to the present LHC limits.

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Evidence for a particle decaying to W+W- in the fully leptonic final state in a standard model Higgs boson search

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The evidence for a new particle decaying to W+W- in the fully leptonic final state in a standard model Higgs boson search is observed. The analysis is performed using 4.9 fb-1 and 19.5 fb-1 of data at the center-of-mass energy 7 TeV and 8 TeV, respectively, collected by CMS detector. The W+W- candidates are selected in the events with two energetic leptons of opposite charges and large missing transverse momentum. The analysis is performed in the four categories in number of jets and lepton flavors to enhance sensitivity. An excess of events consistent with Standard Model Higgs boson of mass around 125 GeV is observed. The inconsistency with the background-only hypothesis is 4.0 standard deviation. Additional Standard Model Higgs-like bosons are excluded in the range of 128-600 GeV. The spin-parity of the new boson is tested against the hypothesis of a narrow spin-2 resonance produced through gluon-gluon fusion mechanism and with minimal couplings to the W+W- pair.

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Observation and coupling measurements of Higgs boson in the diphoton decay mode in ATLAS

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The diphoton decay mode was the most sensitive mode for the discovery of the Higgs-like resonance in 2012. This mode remains very important in the post-discovery era, being sensitive to the existence of new physics. In this talk, I summarize the observation of the resonance in the diphoton channel by the ATLAS experiment using the full Run I dataset. I also describe the measurement of signal strengths and couplings in this channel in the gluon fusion, vector boson fusion and associated production modes.

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Spin measurements of the Higgs-like resonance in the WW->lvlv decay mode in ATLAS

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The characterization of the new boson, discovered in the search for the SM Higgs boson, is currently a priority in high-energy physics. Determination of the J^P quantum numbers of the boson are vital to this end. In the ATLAS collaboration, analyses to discriminate between the J^P = 0+ vs 1+, 1- and 2+ states have been performed in the H->WW->lvlv channel using 21 fb-1 of data at a CM energy of 8 TeV. In this talk, I describe the analyses and present results.

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Spin measurement of the Higgs-like resonance observed in the two photon decay channel in ATLAS

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The high resolution of the diphoton decay mode for the Higgs-like resonance discovered in 2012 provides a useful tool for probing the properties of the new boson. I summarize the observation by the ATLAS experiment of the resonance in the Run 1 dataset, and present measurements of the spin. The compatibility of the observations with the standard model will be discussed.

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Searches for Exotic Higgs decays in CMS

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We present most recent results from CMS on searches for Higgs-like particles in models beyond the Standard Model. Several rare and exotic decay modes of the Higgs boson are explored. The results of the searches are relevant for establishing whether the 125 GeV particle observed in Higgs boson searches at the LHC has the properties expected for a standard model Higgs boson.

Electroweak Symmetry Breaking and the Higgs Sector / 159

Property measurements with Higgs to gamma gamma at ATLAS

Mr. SAXON, James [1]

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Recent results on coupling measurements in the bosonic decay modes have confirmed the Higgs-like properties of the particle discovered in 2012 by the ATLAS and CMS collaborations. Angular correlations of the Higgs decay products or its boost will give further insight into the underlying kinematic properties of the signal production and decay. With the accumulated integrated luminosity of 20/fb in 2012 and the high signal selection efficiency the di-photon decay channel is ideally suited for property measurements of this newly discovered Higgs boson. In this talk we present differential cross-section measurements in the di-photon decay channel, corrected for experimental acceptance and resolution. The amount of background, mainly from SM di-photon production and hadronic jets, is estimated from di-photon invariant mass sidebands and subtracted. We focus on the methods and results of these property measurements, which play an important role in the understanding of the true nature of electroweak symmetry breaking.

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Searches for decays of the Higgs-like boson to tau lepton pairs with the ATLAS detector

Mr. TUNA, Alexander Naip [1]

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Measurements involving the newly discovered boson with a mass of approximately 125 GeV have all been consistent with the Standard Model Higgs boson hypothesis. If this particle is indeed the Standard Model Higgs boson, then it should interact with fermions via Yukawa couplings. The investigation of whether this boson couples to fermions (and in particular leptons) is a fundamental test of this central prediction. This presentation discusses direct searches for leptonic couplings of the new boson by searching for its decays in the ditau channel. The analysis, exploiting each of the \taulep\taulep, \taulep\tauhad, and \tauhad\tauhad final states, is based on data samples of proton-proton collisions collected by the ATLAS experiment at the LHC with centre-of-mass energies of 7 TeV and 8 TeV. The event selection, analysis techniques and systematic uncertainties for these searches are described, and the results are compared with Standard Model predictions.

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Statistical treatment in the search for the Standard Model Higgs boson produced in association with a vector boson and decaying to bottom quarks with the ATLAS detector

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A search for the Standard Model Higgs boson produced in association with a W or Z boson and decaying to $b\bar{b}$ using the ATLAS detector at the LHC is performed. The search uses 4.7 fb^{-1} of data at $\sqrt{s}$ = 7 TeV and 21 fb^{-1} at $\sqrt{s}$ = 8 TeV. The analysis uses events containing zero, one and two leptons. This talk will focus on the one lepton channel, which targets WH to lvbb, and will describe the results of the combination of all three channels.

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Higgs property measurements in ATLAS

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I present measurements of the properties of the newly discovered
boson using the full Run I pp collision dataset recorded
by the ATLAS experiment. The properties include the mass, signal strengths
and couplings of the boson as well as its spin/CP states.
I will discuss the details about the statistical combination of these property measurements from various decay channels and
present the latest combined results.

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Search for associated production WH, ZH with H decaying to b bbar at ATLAS.

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Updated results are shown in the search for the Higgs decay into b-bbar where the Higgs boson is produced in association with a vector boson (W/Z). The search is performed using the complete 2011 and 2012 datasets collected by the ATLAS detector at the LHC. The analysis is done in three different lepton multiplicities (0, 1, and 2 leptons), corresponding to the decays of ZH (Z --> nu + nu), WH (W --> e/mu + nu), and ZH (Z --> ee/mumu), respectively. Results from each category are shown. The final measurement is a combination of all three lepton categories.

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Search for the standard model Higgs boson in the Zgamma decay mode with ATLAS

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The H->Zgamma decay mode is a key to understanding any deviation in signal strength from Standard Model expectation in the H->diphoton decay mode. I summarize the selection, background estimation, statistical treatment and results of search for Standard Model Higgs boson in the channel H->Zgamma, Z->l+l-, where l = e or mu, using the 4.6 fb-1 of proton-proton collisions at sqrt(s)=7TeV and 20.7 fb-1 of proton-proton collisions at sqrt(s)=8TeV recorded by the ATLAS experiment at the LHC. I also describe the recent improvements since the preliminary results presented at the winter 2013 conferences.

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Observation Of A Higgs-Like Boson in the Decay H -> ZZ -> 4 lepton

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CMS results on the search for the Standard Model Higgs boson in the ZZ channel, where the Z bosons decay into two charged leptons each using the full dataset recorded at the LHC from pp collisions at center of masss energies of 7 and 8 TeV, will be presented. The measured Higgs boson properties, such as the mass, decay rate and spin-parity will be discussed.

Field and String Theory / 298

TBA

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Black Hole Firewalls: Flame Suppressants and Burning Questions

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Holographic entanglement beyond classical gravity

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The Renyi entropies and entanglement entropy of 1+1 CFTs with gravity duals can be computed by explicit construction of the bulk spacetimes dual to branched covers of the boundary geometry. At the classical level in the bulk this has recently been shown to reproduce the conjectured Ryu-Takayanagi formula for the holographic entanglement entropy. We study the one-loop bulk corrections to this formula. The functional determinants in the bulk geometries are given by a sum over certain words of generators of the Schottky group of the branched cover. For the case of two disjoint intervals on a line we obtain analytic answers for the one-loop entanglement entropy in an expansion in small cross-ratio. These reproduce and go beyond anticipated universal terms that are not visible classically in the bulk. We also consider the case of a single interval on a circle at finite temperature. At high temperatures we show that the one-loop contributions introduce expected finite size corrections to the entanglement entropy that are not present classically. At low temperatures, the one-loop corrections capture the mixed nature of the density matrix, also not visible classically below the Hawking-Page temperature.

Field and String Theory / 84

Field localization and mass generation in an alternative 5-dimensional brane model

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We consider a 5-dimensional brane world model with a single brane closely related but distinct from the Randall-Sundrum brane model. In particular we focus on the localization of 5D fields with different spins – spin 0, spin 1/2, spin 1 – to the brane. We find that the brane model studied here has different (and in some cases superior) localization properties for fields/particles with different spins compared to the original 5-dimensional brane models.

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Field and String Theory / 300

Conformal Field theories in 3.99 dimensions.

We discuss how crossing symmetry constraints can be analytically continued to non-integer space-time dimension, allowing a formulation of the bootstrap program in fractional dimensions.
We show evidences of the existence of a families of CFT's connecting the Ising Model in 2D and the Wison-Fisher perturbative fixed points. We analyze properties of these CFT's and we compare with known results.

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Bootstrapping the O(N) Vector Models

We study the conformal bootstrap for 3D CFTs with O(N) global symmetry. We obtain rigorous upper bounds on the scaling dimensions of the first O(N) singlet and symmetric tensor operators appearing in the \phi_i x \phi_j OPE, where \phi_i is a fundamental of O(N). Comparing these bounds to previous determinations of critical exponents in the O(N) vector models, we find strong numerical evidence that the O(N) vector models saturate the bootstrap constraints at all values of N. We also compute general lower bounds on the central charge, giving numerical predictions for the values realized in the O(N) vector models. We compare our predictions to previous computations in the 1/N expansion, finding precise agreement at large values of N.

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Flux Compactifications

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Holographic entanglement entropy and higher spin gravity

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Spectral Network and Wall-Crossing of Argyres-Douglas theories

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Topologically Massive Yang-Mills Theory and Link Invariants

Mr. YILDIRIM, Tuna [1]; Prof. RODGERS, Vincent [1]; Prof. NAIR, Parameswaran [2]; Ms. CARTER, Suzanne [1]

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2+1 dimensional gauge theories have been an important theoretical testing ground for new ideas that could potentially be used in 3+1D. After three decades, a good understanding of 2+1D non-Abelian gauge theories still seems out of reach. Many think that using link invariants of knot theory may lead to a better understanding of these theories. With this motivation, we study Chern-Simons(CS) + Yang-Mills theory, also known as topologically massive Yang-Mills theory(TMYM). Using geometric quantization, we calculate the wave-functional for TMYM theory in order to get Wilson Loop expectation values. Then, at large distances where only a topological theory survives, we compare CS and TMYM Wilson Loop expectation values to get a condition that can make Skein relations of knot theory useful for TMYM theory. Furthermore, we study the TMYM Hamiltonian and finally we comment on the mass gap of the theory.

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-Cancelled- Formalism and applications of heavy particle effective field theories

Prof. HILL, Richard [1]; SOLON, Mikhail [1]; LEE, Gabriel [1]; Dr. HEINONEN, Johannes [1]

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Employing induced representations of the Lorentz group (Wigner's little group construction), formalism for constructing heavy particle effective Lagrangians is developed, and Lagrangian constraints enforcing Lorentz invariance of the S matrix are derived. The relationship between Lorentz invariance and reparameterization invariance is established and it is shown why a standard ansatz for implementing reparameterization invariance in heavy fermion effective Lagrangians breaks down at order 1/M^4. Formalism for fields of arbitrary spin and for self-conjugate fields is presented, and the extension to effective theories of massless fields is discussed.

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The covariant, time-dependent Aharonov–Bohm effect

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We discuss two possible covariant generalizations of the Aharonov–Bohm effect – one expression in terms of the space–time line integral of the four-vector potential and the other expression in terms of the space–time “area” integral of the electric and magnetic fields written in terms of the Faraday2-form. These expressions allow one to calculate the Aharonov–Bohm effect for time-dependent situations.In particular, we use these expressions to study the case of an infinite solenoid with a time varying flux and find that the phase shift is zero due to a cancellation of the Aharonov–Bohm phase shift with a phase shift coming from the Lorentz force associated with the electric field, E = –dA/dt, outside the solenoid.This result may already have been confirmed experimentally.

Field and String Theory / 266

A New Motivation for WIMP Dark Matter

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I will discuss constraints necessary for the consistency of certain 4d string compactifications which go beyond those necessary for vanilla anomaly cancellation. Most realizations of the standard model do not satisfy these constraints, motivating the addition of new electroweak multiplets which are often protected by symmetry. This provides a new theoretical motivation for WIMP dark matter which neither requires nor precludes weak-scale supersymmetry.

Neutrino Physics / 216

New results on Neutrino Magnetic Moments and on Democratic Neutrinos

Dr. ZHURIDOV, Dmitry [1]; Prof. PETROV, Alexey [1]; Dr. HEALEY, Kristopher [1]

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I will discuss the two separate issues on neutrino physics. First, the new bounds on tensorial couplings of neutrinos to charged fermions from the existing limits on neutrino transition magnetic moments. Second, explanation of the atmospheric and solar neutrino data for the democratic neutrinos with only one mass splitting, using the effect of incoherence.

Neutrino Physics / 166

Charged Current Quasi-Elastic Scattering at MINERvA

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"MINERVA is a neutrino scattering experiment at Fermilab that studies the interactions of muon neutrinos and antineutrinos with various nuclear targets composed of plastic scintillator and a suite of nuclear targets composed of helium, carbon, iron, lead and water placed upstream of the active region. Minerva was designed to provide input support for neutrino oscillation experiments and as a pure weak probe of the nuclear medium. Minerva recently released first results related to muon neutrino and antineutrino quasi-elastic scattering (http://arxiv.org/abs/1305.2234 and http://arxiv.org/abs/1305.2243). These results, which will be described in this talk, shed light on the effect of the nuclear medium on both the muon kinematics and the energy deposited near the interaction vertex in quasi-elastic interactions."

Neutrino Physics / 0

Measuring Neutrino Oscillations with the MINOS Experiment

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The observation of neutrino oscillation provided the first evidence for physics beyond the standard model. MINOS has been one of the foremost experiments in the field. Pioneering the two-detector technique, the MINOS long-baseline oscillation experiment has made several world-class neutrino oscillation measurements, not only making the most precise measure of the largest neutrino mass splitting, but also the first direct measurement of the antineutrino oscillation parameters. This presentation provides a definitive summary of the contribution MINOS has made to the world's knowledge of theta_23 and delta m^2_32 through the observation of muon neutrino and antineutrino disappearance.

Neutrino Physics / 283

Observation of High-Energy Neutrinos with IceCube

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The origin of high-energy cosmic rays is one one of the most persistent mysteries in physics. Neutrinos, as neutral tracers of hadronic acceleration, may offer a new and unique window into this problem and others in high-energy astrophysics. This talk will discuss recent results from the antarctic IceCube neutrino observatory, the first operating gigaton-scale neutrino detector, showing first evidence for a population of extremely high energy neutrinos (100+ TeV) that cannot easily be explained by processes occurring in cosmic ray showers in the Earth's atmosphere and may represent the first evidence for a population of high-energy neutrinos of extraterrestrial origin.

Neutrino Physics / 269

The Precision IceCube Next Generation Upgrade (PINGU)

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The IceCube Neutrino Observatory, completed in 2010 and located at the
geographic South Pole, is the largest neutrino telescope in the world.
IceCube includes the more densely instrumented DeepCore subarray, which
increases IceCube's sensitivity at neutrino energies down to 10 GeV.
DeepCore has recently demonstrated sensitivity to muon neutrino
disappearance from atmospheric neutrino oscillation. A further extension is under consideration, the Precision IceCube Next Generation Upgrade (PINGU) which would lower the energy threshold and increase the sensitivity to low energy neutrino physics. In particular, PINGU would be sensitive to the effects of the neutrino mass hierarchy, which is one of the outstanding questions in particle physics. I will discuss the planned PINGU array and its potential for new physics.

Neutrino Physics / 268

Future Sensitivity of the T2K Long-Baseline Neutrino Experiment

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Following the measurement of $\sin^22\theta_{13}$ by T2K and reactor experiments, the T2K long-baseline neutrino experiment at the proposed full statistics may now have other enhanced sensitivities. A combined fit of the T2K dataset of $\nu_\mu\rightarrow\nu_e$ appearance, $\nu_\mu\rightarrow\nu_\mu$ disappearance, ν-mode beam, and $\bar{\nu}$-mode beam data can provide very interesting constraints on the four relevant oscillation parameters ($\sin^22\theta_{13}$, δ_{CP}, $\sin^2\theta_{23}$, and Δm^2_{32}). Combined fits to MC simulations of these four datasets at the T2K full statistics are therefore performed, where the current T2K systematic errors are accounted for using a systematic error covariance matrix. The ultimate T2K sensitivities, as determined assuming different possible true values for the oscillation parameters, as well as different T2K ν-mode and $\bar{\nu}$-mode running times, will be shown.

Neutrino Physics / 57

Using Fast Photosensors in Water Cherenkov Neutrino Detectors

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Many of the yet unanswered questions in neutrino physics, such as CP violation in the lepton sector or neutrino mass hierarchy, could be answered with higher sensitivity neutrino experiments. New photodetectors based on micro-channel plates are being developed by the Large-Area Picosecond Photo Detector (LAPPD) Collaboration. These photosensors have been shown to have excellent spatial and timing resolution. Using these devices in massive water Cherenkov detectors, we could significantly improve the vertex resolution for neutrinos enhancing background rejection for neutrino oscillation experiments. We present preliminary results on the reconstruction capabilities for single particles in water Cherenkov detectors using fast photosensors.

Neutrino Physics / 296

Electron capture spectroscopy and isotope production: research toward neutrino mass measurement

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Calorimetric spectroscopy via electron capture (ECS) is a candidate for a direct measurement of the neutrino mass, for isotopes with a Q-value of a few KeV. The use the synthetic, rare, and unusual isotope Ho-163 has significant advantages but substantial new challenges. Two absolutely essential challenges to overcome are the production of Ho-163 and measuring ECS spectra with very high resolution: There are no fully validated methods for making Ho-163 at the purities and quantities required. Nor has there been any ECS of any isotope with the required 1-2 eV FWHM resolution. We will report on both areas. We discuss the possible methods of accelerator and reactor production and the separation of Ho-163 by high-pressure liquid chromatography. Our transition edge sensor testing has used a surrogate electron-capture-decaying isotope, Fe-55, embedded within microcalorimeter absorbers. This encapsulation aims to capture and thermalize all the energy of the excited daughter atom (Mn-55) independent of the de-excitation pathway. Preliminary tests so far have shown better than 10 eV resolution for Fe-55 embedded in small Au absorbers attached to TES microcalorimeters, with variability based on encapsulation method and isotopic purity.

Neutrino Physics / 164

The LArIAT Experiment

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Liquid Argon Time Projection Chambers are quickly becoming one of the main detector technologies in neutrino physics. They offer very good 3D and calorimetric resolution and allow relatively easy construction of large mass detectors making them a prime candidate for future precision neutrino measurements. Surprisingly, there has been relatively little effort in calibrating these detectors. The LArIAT (Liquid Argon In A Testbeam) experiment aims to fill that gap. Running in the Fermilab testbeam facility on a beam of charged particles of known momentum it will seek to measure and refine the LArTPC's Particle Identification capabilities, including the e/gamma separation, electron recombination parameters and non magnetic muon sign determination amongst others. The status of the construction of the first phase of the experiment, which will reuse the ArgoNeuT TPC, will be presented as well as plans for the second phase which will examine containment of EM and hadronic showers.

Neutrino Physics / 195

Update from the ArgoNeuT Experiment

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ArgoNeuT, a 175 liter Liquid Argon Time Projection Chamber (LArTPC), exposed to NUMI beamline at Fermilab (2009-2010), has collected thousands of neutrino and anti-neutrino events between 0.1 and 10 GeV. ArgoNeuT is the first LArTPC exposed to a low energy neutrino beam, first ever in the US in neutrino beam and the second LArTPC exposed to a neutrino beam ever. The project is part of the LArTPC development program in the US and has helped initiate the development of simulation and reconstruction tools for LArTPCs. This talk will include a reminder of the detector details, and will then update the status of completed and ongoing analysis using ArgoNeuT data.

Neutrino Physics / 112

A data-driven method of background prediction at NOvA

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NOvA is a long-baseline neutrino oscillation experiment that will use the NuMI beam originating at Fermilab. NOvA enables the study of two oscillation channels: ν_{μ} disappearance and ν_{e} appearance. It consists of two functionally identical detectors, the Near Detector (ND) at FNAL and the Far Detector (FD) near International Falls in Northern Minnesota. The ND will be used to study the neutrino beam spectrum and composition before oscillation, and measure background rate to the ν_e appearance search. In this talk, I will describe a data-driven way of estimating the neutral current (NC) component of the ND spectrum. Using the ν_{μ} CC interactions where the reconstructed muon is removed from the event, we produce a well understood sample of hadronic events that resemble NC interactions.

Neutrino Physics / 83

Barium Tagging for EXO

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In order to perform a background-free measurement of neutrinoless double-beta decay in xenon, the EXO collaboration is developing several techniques to recover and identify the barium daughter nucleus. Resonance Ionization Spectroscopy (RIS) has been shown to be both efficient and selective, both favorable aspects for a barium-tagging system. We have constructed a test setup for extracting barium ions from liquid xenon using RIS. Barium daughter ions adsorb as neutral atoms on a metallic surface, which we remove to a separate vacuum chamber for identification. These atoms are thermally desorbed from the surface into vacuum using an infrared laser, then re-ionized by RIS and drifted down a time of flight spectrometer. This system offers both optical spectroscopic and mass spectroscopic confirmation of the barium daughter.

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Future Neutrino Oscillation Sensitivities for LBNE

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The primary goal of the Long-Baseline Neutrino Experiment (LBNE) is to measure the neutrino mixing matrix parameters. The design, optimized to searching for CP violation and determining the neutrino mass hierarchy, includes a large ($\mathcal{O}~10~kt$) Liquid Argon Time Projection Chamber (LAr TPC) at 1300 km downstream of a wide band neutrino beam. A brief introduction to the neutrino mixing parameters will be followed by a discussion of sensitivity study analysis methods and a summary of LBNE sensitivities. The studies include comparisons with the Tokai to Kamioka (T2K) and NuMI Off-Axis Electron-neutrino Appearance (NOvA) experiments as well as combined sensitivities. Finally, the impact of including a realistic set of systematic uncertainties will be presented.

Neutrino Physics / 243

Latest results from Daya Bay

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The Daya Bay experiment has observed well over a million electron anti-neutrino interactions in detectors 2 km or less from six nuclear reactors. The latest results on electron anti-neutrino disappearance and reactor flux will be presented.

Neutrino Physics / 258

LBNE Near Detector

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The Long-Baseline Neutrino Experiment is a broad scientific program being developed in the United States as an international partnership. LBNE consists of an intense neutrino beam produced at Fermi National Accelerator Laboratory (Fermilab), a highly capable set of neutrino detectors on the Fermilab campus, and a large underground liquid argon time projection chamber (TPC) at Sanford Underground Research Facility (SURF) in the state of South Dakota. The high-intensity neutrino beam will allow LBNE to make high precision measurements of neutrino and anti-neutrino mixing separately. LBNE will make detailed studies of neutrino oscillations including measurements of the mass hierarchy and CP violation that take advantage of the 1300 km baseline afforded by this arrangement. At the near site, the high-statistics neutrino scattering data will allow for many cross-sections measurements and precision tests of the standard model. While reducing the uncertainties on the long-baseline oscillation analyses are their primary mission, the near detectors enable searches for physics beyond the standard model as well as measurements of processes important for systematic uncertainty reduction in the study of atmospheric neutrinos and searches for nucleon decay at the far site. In this talk, we describe the near detectors in detail and outline the broad physics program that will be carried out at the LBNE near site.

Neutrino Physics / 259

The CAPTAIN detector and physics program

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The Cryogenic Apparatus for Precision Tests of Argon Interactions with Neutrinos (CAPTAIN) program is designed to make measurements of scientific importance to long-baseline neutrino physics and physics topics that will be explored by large underground detectors. CAPTAIN began as part of a Los Alamos National Laboratory (LANL) Laboratory Directed Research and Development (LDRD) project and has evolved into a multi-institutional collaboration. The CAPTAIN detector is a liquid argon time-projection chamber (TPC) deployed in a portable cryostat. Five tons of liquid argon are instrumented with a 2,000 channel TPC and a photon detection system. The cryostat has ports that can hold optical windows for laser calibration and for the introduction of charged particle beams. Assembly of the detector is underway. In this talk, we discuss the status of detector commissioning the physics program for CAPTAIN. The first stage of the program involves impinging a well-characterized neutron beam on the detector to take neutron data in a liquid argon TPC for the first time. The subsequent phase includes exposures to intense neutrino beams.

Neutrino Physics / 178

A Search for Sterile Neutrinos at MINOS and Prospects for MINOS+

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A new search for disappearance of active neutrinos over a baseline of 735 km was conducted using the NuMI neutrino beam and the MINOS detectors. The data analyzed correspond to an exposure of 10.56e20 protons-on-target. The neutral-current candidate spectrum measured at the Far Detector is compared with predictions assuming standard mixing between three active neutrino flavors. Both neutral-current and charged-current spectra are also fitted to neutrino oscillation models assuming one sterile neutrino. In this talk, new results using MINOS data and prospects for MINOS+ using the upgraded NuMI beam are presented.

Neutrino Physics / 248

Super-Kamiokande and T2K Joint Fit Studies for Neutrino Oscillation Parameters

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I report on studies to combine the three-flavour neutrino oscillation fits to the Super-Kamiokande atmospheric data and the T2K long baseline data. With the
establishment of large \sin^2(\theta_{13}) we now turn our attention to the
remaining undetermined parameters in the neutrino sector, the mass hierarchy,
\sin^2(\theta23) octant and \delta_{cp} phase. By probing these parameters
simultaneously using multiple neutrino species at different energies and with
different baselines we may be able to resolve the inherent degeneracies. The
combination of Super-Kamiokande and T2K offers such a possibility. In a phased
approach we begin with the simplest means of combining the results and plot a course for future studies.

Neutrino Physics / 187

Project 8: Using Radio-Frequency Techniques to Measure Neutrino Mass

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The Project 8 experiment aims to measure the neutrino mass using tritium beta decays. Beta-decay electron energies will be measured with a novel technique: as the electrons travel in a uniform magnetic field their cyclotron radiation will be detected. The frequency of each electron's cyclotron radiation is inversely proportional to its total relativistic energy; therefore, by observing the cyclotron radiation we can make a precise measurement of the electron energies. The advantages of this technique include scalability, excellent energy resolution, and low backgrounds. The collaboration is using a prototype experiment to study the feasibility of the technique with a ^{83m}Kr source. Demonstrating the ability to see the 17.8~keV and 30.2~keV conversion electrons from ^{83m}Kr will show that it is possible to measure tritium beta-decay electron energies ($Q \approx 18.6$~keV) with their cyclotron radiation. Progress on the prototype, analysis and signal-extraction techniques, and an estimate of the potential future of the experiment will be discussed. This research is supported in part by DOE grant DE-FG02-97ER41020 and the National Science Foundation.

Neutrino Physics / 189

Expected Sensitivities from the ν_{μ} Disappearance Analysis using the NOνA Detector.

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The NOνA experiment is a neutrino oscillation experiment based out of Fermilab. It will use the newly upgraded NuMI beam line with one detector at Fermilab and a second 14 kton, liquid scintillator detector currently being constructed 810 km from Fermilab in northern Minnesota. The ν_{μ} disappearance analysis can significantly improve the world's best measurement of θ_{23} and $|\Delta m^2_{32}|$. Presented here are the expected sensitivities from this analysis as well as initial commissioning data from the far detector.

Neutrino Physics / 185

Multiple Probes of Lorentz Violation with Reactor Antineutrinos

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As natural interferometers, neutrino oscillations provide a unique and sensitive tool to look for the violation of Lorentz invariance. The Double Chooz experiment has recently searched for a sidereal time dependence among the electron antineutrino candidates as a probe of Lorentz violation. This analysis represents the first such search using antineutrino oscillations at a reactor-based experiment. In a follow up analysis, the energy dependence of the events has also been studied for sensitivity to Lorentz violation. Both of these analyses will be presented.

Neutrino Physics / 99

Status and Results from EXO-200

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EXO-200 is an ongoing experiment searching for neutrinoless double beta decay using 136Xe.
Such a search can shed light on the Majorana nature of the neutrino (whether the neutrino is its own anti-particle), the absolute mass scale of neutrinos, and beyond standard model processes that violate lepton number conservation. The EXO-200 detector uses 200 kg of xenon with 80% enrichment in 136Xe in a single-phase liquid xenon time projection chamber (TPC). The double beta decay of xenon is detected in the ultra-low background TPC by collecting both the scintillation light and the ionization charge. The detector has been taking low background physics data with enriched xenon at the Waste Isolation Pilot Plant (WIPP) in New Mexico since early May 2011. The results produced from the collaboration include the first observation of two-neutrino double beta decay of 136Xe, and a neutrinoless double beta decay search result that places one of the most stringent limits on the effective Majorana neutrino mass. A significant amount of data has been taken since the first 0nbb results, and the data analysis tools have been refined. If time permits, I will briefly discuss the prospects of a future multi-tonne scale experiment named nEXO.

Neutrino Physics / 168

MicroBooNE

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MicroBooNE is a liquid Argon time projection chamber designed to study the excess of low energy events observed at MiniBooNE. The detector is now under construction and will begin taking data at Fermilab in 2014. This talk will cover the experimental goals along with the recent results in the R for the detector.

Neutrino Physics / 229

Measurement of Charged-Current ν_{e} On-Water Interaction Rate with the PiZero Detector at T2K

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T2K is a long-baseline neutrino oscillation experiment designed to observe ν_{e} appearance in a ν_{μ} beam. The objective of the PiZero detector (P0D), which is a part of the T2K off-axis near detector ND280, is to characterize the T2K neutrino beam and to measure neutrino cross-sections, in particular the neutral-current single pi-zero production cross-section. The design of the P0D includes fillable water targets, which allows to measure on-water neutrino interaction cross-sections. In this talk, an analysis of charged-current ν_{e} on-water interactions, which is the largest background for the ν_{e} appearance measurement, within the P0D will be presented. The selection criteria and systematic uncertainty studies will be explained and preliminary results will be shown.

Neutrino Physics / 220

Tau neutrino as a probe of nonstandard interactions via charged Higgs and W' contribution

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We consider charged Higgs and W' gauge boson contributions to the quasielastic, Δ-resonance, and deep inelastic processes in the tau-neutrino nucleon scattering $\nu\tau+N\rightarrow\tau^{-}+X$ and $\bar{\nu}\tau+N\rightarrow\tau^{+}+X$. These effects modify the standard model cross section for these processes and thus impact the extraction of the neutrino mixing angles θ_{23} and θ_{13}. We include form factor effects in our calculations and find the deviation of the actual mixing angle from the measured one, assuming the standard model cross section, can be significant and can depend on the energy of the neutrino.

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High-Angle NuMu CCQE Measurements at T2K Using the Pi-0 Detector for Low-Energy Events

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T2K is an off-axis, long baseline neutrino oscillation experiment designed to measure numu to nue transition probabilities and their associated oscillation parameters. The detection apparatus consists of a suite of near detectors 280 m from the beam target (collectively referred to as ND280), and the Super-Kamiokande water Cherenkov detector 295 km away. The Pi-0 Detector (P0D) is a component of ND280 designed to measure the production of NC pi-0's on water to constrain backgrounds at the far detector. While not optimized for lepton tracking and identification, it can still provide a useful sample of CC interaction events, including events at energies near the peak beam energy (~600 MeV).
This talk will outline a method to use the P0D and surrounding electromagnetic calorimeters to identify these low-energy (>800 MeV) numu CCQE interactions within the P0D and to accurately measure the pertinent final state kinematics. I will also discuss how this measurement can supplement existing T2K analyses by providing a significant increase in both the statistics and the phase space accessible to ND280.

Neutrino Physics / 239

Analysis of ν_e appearance from an off-axis ν_{μ} beam utilizing neutrino energy spectrum

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T2K is a long baseline neutrino experiment in Japan using a 30 GeV proton beam at the J-PARC accelerator to produce an intense off-axis μ neutrino beam. One of its primary goals is to measure neutrino oscillation parameters by directly detecting ν_e that have oscillated from a ν_{μ} beam. In this talk, I will describe the recent 2013 ν_e appearance oscillation analysis using the reconstructed neutrino energy spectrum by means of a maximum likelihood fit. The data used for this analysis corresponds to 6.93$\times10^{20}$ POT. I will also go over recent improvements to the analysis and present the newest results.

Neutrino Physics / 42

NOvA experiment: overview and status

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The NOvA experiment is a long-baseline accelerator based neutrino oscillation experiment. It uses the upgraded Fermilab NuMI beam and measures electron-neutrino appearance and muon-neutrino disappearance at its far detector in Ash River, Minnesota. Goals of the experiment include measurements of theta13, the neutrino-mass hierarchy and the CP-violating phase. NOvA has begun to take data this year and will have its first physics results in 2014. This talk provides an overview of the scientific reach of the NOvA experiment, the status of detector construction and physics analysis and a first glimpse of far-detector data.

Neutrino Physics / 250

The MAJORANA DEMONSTRATOR double-beta decay experiment

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The MAJORANA DEMONSTRATOR is a 40 kg array of high purity germanium detectors being constructed at the 4850 foot level of the Sanford Underground Research Facility. Up to 30 kg of these detectors will be enriched to greater than 86% in in germanium-76. The goal of the DEMONSTRATOR is to establish the feasibility of constructing a tonne-scale, germanium based double-beta decay experiment by demonstrating a background rate less than 3 counts/tonne/year in the 4 keV wide germanium-76 neutrinoless double-beta decay region of interest. The first module of detectors is expected to begin taking data at the end of 2013. This presentation will discuss the DEMONSTRATOR construction status and outlook.

Neutrino Physics / 141

Searching for Sterile Neutrinos and CP Violation: The IsoDAR and Daedalus Experiments

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The IsoDAR experiment uses a novel isotope decay-at-rest (DAR) source of electron antineutrinos produced using protons from a 60 MeV cyclotron. Paired with the KamLAND detector, the experiment can observe over 800,000 inverse beta-decay events in five years and perform a decisive test of the current hints for sterile neutrino oscillations. Daedalus is a phased program leading to a high-sensitivity search for CP violation in the neutrino sector. The experiment uses a set of high-intensity 800 MeV cyclotrons to produce pion DAR neutrino sources at several locations (1.5km, 8km, and 20km) going to a single, ultra-large, underground detector with free protons. The Daedalus experiment will provide a high-statistics antineutrino data set with no matter effects that can be combined with long-baseline data sets to provide enhanced sensitivity to CP violation and matter effects.

Neutrino Physics / 77

A new measurement of reactor antineutrino disappearance using neutron captures on hydrogen and gadolinium in the Double Chooz far detector

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To enhance sensitivity to electron antineutrino oscillations, the Double Chooz collaboration has developed a variety of innovative analysis techniques. Double Chooz is the only reactor antineutrino experiment to expand the inverse beta decay search to include neutron captures on hydrogen as well as the standard gadolinium captures. As of summer 2013, it the only experiment of its kind to exploit the energy dependence of oscillations. Finally, through a separate study based on reactor power modulation, Double Chooz has made the only $\sin^2 2\theta_{13}$ measurement which does not depend on \textit{a priori} predictions of background rates or spectra. In this talk, we report a new rate-and-energy-spectrum analysis which combines Double Chooz hydrogen and gadolinium capture results. We also report results of a reactor power-based analysis with unique independence from background modeling.

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Transverse Enhancement and Meson Exchange Current Contributions to Quasielastic Neutrino Scattering on Nuclear Targets

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We use quasielastic electron scattering data on nuclear target to parametrize the enhancement to the transverse response functions in nuclear targets. This enhancement has been attributed to meson exchange currents in nuclei. We parametrize both the overall magnitude of the enhancement and the contribution to the width of the quasielastic peak.
The model is in good agreement with recent measurements of MiniBooNE and MINERvA.

Outreach Activities / 310

Presentation on Outreach Activities

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Physics Beyond the Standard Model / 219

Search for exotic top-quark partners

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We present searches for massive top and bottom quark partners at CMS using data collected at sqrt(s)=7 and 8 TeV. Such partners can be seen in 4th generation models, or can be found in models predicting vector-like quarks to solve the Hierarchy problem and stabilize the Higgs mass. The searches span a range of final states, from multi-leptonic to entirely hadronic, and limits are set on mass and production cross sections as a function of branching ratios.

Physics Beyond the Standard Model / 139

Natural, R-parity violating supersymmetry and horizontal flavor symmetries

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Motivated by null LHC searches for R-parity conserving SUSY, I will present the general structure of RPV couplings in presence of a Froggatt-Nielsen horizontal symmetry. For sub-TeV SUSY, lepton number must be an accidental symmetry, while baryonic RPV allows natural low-energy SUSY. The upper limit for the magnitude of the largest RPV coupling is 10^{-3} (from dinucleon decay) while the lower limit is 10^{-9} (from missing E_T SUSY and R-hadrons searches), and displaced vertices are predicted in about half of this range.

Physics Beyond the Standard Model / 160

Muon g-2 at Fermilab: Probing for BSM Physics

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The Muon g-2 experiment at Fermilab will measure the anomalous magnetic moment of the muon, a_{μ}, to 0.14 ppm. With a factor of four improved precision over the statistically limited Brookhaven E821 experiment, we will test the 3.6 σ discrepancy between the Standard Model theory prediction and experimental results. Possible sources of this hint of new physics will be described and experimental upgrades will be discussed. The status of this summer's cross-country storage ring transport from Brookhaven to Fermilab will be highlighted.

Physics Beyond the Standard Model / 122

Search for lepton number violation in B-meson decays

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We present a search for fourteen lepton-number violating
processes B --> X-l+l+, where X- = K-, pi-, rho-, K*-, or anti-p,
and l+ = e+ or mu+, with a sample of about 470 million B anti-B pairs
collected with the BaBar detector at the PEP-II
asymmetric-energy e+e- collider at SLAC.

Physics Beyond the Standard Model / 125

Hadron production in e+e- annihilation at BaBar, and implication for the muon anomalous magnetic moment.

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The BABAR Collaboration has an intensive program of studying hadronic cross sections at low-energy e+e- collisions, accessible at BaBar via initial-state radiation. Our measurements allow significant improvements in the precision of the predicted value of the muon anomalous magnetic moment. These improvements are necessary for shedding light on the current ~3.5 sigma difference between the predicted and the experimental values. We have published results on a number of processes with two to six hadrons in the final state. We report here the results of recent studies with the final states that constitute the main contribution to the hadronic cross section in the energy region between 1 and 3 GeV, as e+e- -> K+K-, K0S K0L, and e+e- -> 4 hadrons.

Physics Beyond the Standard Model / 63

Search for direct production of charginos and neutralinos in events with three leptons and missing transverse momentum with the ATLAS Detector

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Supersymmetry offers an elegant solution to the hierarchy problem and can provide a candidate for dark matter. As the limits on squark and gluino masses are pushed beyond the TeV range, direct production of charginos and neutralinos can become the dominant sparticle production at the LHC. Also, light charginos and neutralinos are favored in "Natural SUSY" models with small fine-tuning of the quantum corrections to the Higgs mass. I present the latest search results in the C1N2 -> lllnuN2N2 channel with the ATLAS detector using the full 8 TeV data collected in 2012. We look for events with three or more isolated leptons of any flavor and large missing transverse momentum. We consider decays mediated by intermediate light sleptons as well as Standard Model gauge bosons. Our results are formulated in terms of simplified models as well as the phenomenological MSSM.

Physics Beyond the Standard Model / 194

g-2 Bounds on Scalar Dark Matter Annihilation

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g-2 correction has been accurately measured in the E821 experiment at Brookhaven National Lab (BNL). Theoretical calculations of the loop corrections to the fermion bremsstrahlung predict the observations quite well. Yet there remains a $~10^-4% > 3\sigma$ difference between experiment and theory.

One way that this discrepancy can be interpreted is by new candidate particles running in the loop. The smallness of the discrepancy leaves only small room for corrections to the standard model. Thus providing a tight constraint on the coupling of such particles to standard model particles. Popular scenarios involve particles such as the supersymmetric particles, the "dark photon", and dark matter. Previously, the bound has been applied to constrain scattering cross sections of these new particles for direct detection.

In this work the bound is applied to constrain the annihilation cross section for indirect detection. The g-2 contribution comes from the $F_2(0)$ term of the vertex correction. This puts an upper bound on the real part of the coupling constant. For this model where the mediator is electromagnetically charged, one can also repeat the same exercise for an electric dipole moment (EDM). The EDM contribution comes from the $F_3(0)$ term of the vertex correction. This puts an upper bound on the imaginary part of the coupling constant which is the CP violating part. This combination will be shown to put a complete upper bound on the annihilation cross section of a scalar dark matter in the $m_f\to0$ limit.

If we consider the limit where the mediator is a lot heavier than dark matter, we find that the bound on annihilation to the electrons is 1.0x10^-7[pb](g-2) + 2.2x10^-15[pb](EDM) and the muons is 1.4x10^-4[pb](g-2) + 45[pb](EDM). The parentheses indicate the quantity used to obtain the values. It is interesting to note that the bound on the electron is dominated by the g-2 measurement, whereas the muon is dominated by the EDM measurement. Especially interesting is this latter case of muon bound. If the dark matter is observed through an annihilation to muon channels with a cross section high above the g-2 bound of 1.4x10^-4[pb], then EDM contribution must be dominant. The dark matter coupling is CP violating in this scenario.

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Correlating Direct and Indirect Detection

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Recent developments have suggested that the dark sector may be much more complex than previously imagined. As a result, models such as Dynamical Dark Matter --- in which there are multiple dark-matter components which are only semi-stable but nevertheless contribute non-trivially to $\Omega_{\rm CDM}$ --- merit further study. One interesting potential signal which arises in such contexts stems from the possibility of the inelastic scattering of heavier states into lighter states at direct-detection experiments. The operators which allow such behavior also permit heavier dark-matter states to decay to lighter dark-matter states plus visible matter. Thus, these models offer the intriguing possibility of actually correlating the bounds from direct detection (scattering) and indirect detection (decay). In this talk I will describe the results of a model-independent analysis of the constraints on decaying dark matter within the region of parameter space relevant for inelastic scattering.

Physics Beyond the Standard Model / 117

B->D(*) tau nu and constraints on charged Higgs models

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We present the measurement of B -> D(*) tau nu decay, which is sensitive at tree level to New Physics contributions in the form of a charged Higgs boson. The measured branching fraction is 3.4 sigma larger than the SM predictions, and excludes the 2HDM of type 2 with a 99.8% confidence level for any value of tan(beta)/mHiggs.
Additional studies of the momentum transfered to the lepton system show that the result can be accomodated by more general two-Higgs-Doublet models.

Physics Beyond the Standard Model / 92

Search for anomalous production of events with same-sign dileptons and b jets in pp collisions at sqrt(s) = 8 TeV with the ATLAS detector

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A search is presented for exotic processes that result in final states containing jets including at least one b jet, sizable missing transverse momentum, and a pair of leptons with the same electric charge. There are several models that predict an enhanced rate of production of such events beyond the expectations of the Standard Model. The ones considered here are pair production of chiral b' quarks, pair production of vector-like quarks, enhanced same-sign top quark pair production, and four top quark production. Using a sample of 14.3 fb^{-1} of pp collisions at sqrt(s) = 8 TeV recorded by the ATLAS detector at the Large Hadron Collider, with selection criteria optimized for each signal, 95\% confidence level limits are set on, e.g., the mass of the new particles, and the cross section of the new processes. For some models, specific branching ratios are assumed for the decays of the new particles.

Physics Beyond the Standard Model / 308

Future sensitivity studies for Supersymmetry searches at CMS at 14 TeV

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The sensitivity for CMS searches for supersymmetry is evaluated in the context of an upgraded LHC at a center-of-mass energy of 14 TeV and an integrated luminosity of 300 fb-1. Results for several key searches for supersymmetry are presented including direct and gluino-mediated stop and sbottom production and electroweak production of supersymmetric particles.

Physics Beyond the Standard Model / 245

Pulling Out All the Stops: A Jet Substructure Search for Light Stops Decaying via Baryonic RPV

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If the lighter stop eigenstate decays directly to two jets via baryonic R-parity violation, it could have escaped existing LHC and Tevatron searches, even for masses as small as 100~GeV. The traditional approach to such a direct RPV stop pair search is to identify a bump in the joint spectrum of dijet pairs in four-jet events. However, this style of search seems to be in a losing race. As luminosity rises, so too do multijet trigger thresholds, and the mass ranges of searches are being forced to slide upwards before exclusion-level sensitivity can be achieved. In order to recapture sensitivity to light RPV stops in the face of increasingly harsh trigger requirements, we propose a search for stop pairs in the highly-boosted regime, using the well-tested approaches of jet substructure.

Physics Beyond the Standard Model / 108

Search for dark sector at BaBar

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Among dark matter theories, the possibility of dark sector(s) has recently received much attention. This class of models introduces a new dark sector with WIMP-like dark matter particles charged under a new Abelian gauge group. The corresponding gauge boson, dubbed a dark photon, must be lighter than a few GeV to explain recent astrophysical and terrestrial anomalies. The dark photon couples to the Standard Model through its kinetic mixing with the photon, and can therefore be produced at low-energy e+e- colliders in Bremsstrahlung reactions. We present a search for dark photon production at BaBar.

Physics Beyond the Standard Model / 88

Model-independent searches for new physics in multilepton final states with the ATLAS detector

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A model independent search for new physics in multilepton final states is presented using 20 inverse femtobarns of proton-proton collisions at a center-of-mass energy of 8 TeV collected by the ATLAS experiment at the CERN Large Hadron Collider. Events with three or more leptons are categorized based on their flavor content and presence of a Z-boson candidate. Signal regions are constructed by making cuts on kinematic variables sensitive to lepton kinematics, jet activity, missing transverse momentum, and heavy flavor production. The results of the search are presented in a model-indepenent format. Fiducial efficiencies for leptons are also provided, which can be used along with the results to constrain untested models of new physics producing multilepton final states.

Physics Beyond the Standard Model / 252

Universal behavior in the scattering of heavy, weakly interacting dark matter on nuclear targets

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Particles that are heavy compared to the electroweak scale ($M \gg m_W$), and that are charged under electroweak SU(2) gauge interactions display universal properties such as a characteristic fine structure in the mass spectrum induced by electroweak symmetry breaking, and an approximately universal cross section for scattering on nuclear targets. The heavy particle effective theory framework is developed to compute these properties. As illustration, the spin independent cross section for low-velocity scattering on a nucleon is evaluated in the limit $M \gg m_W$, including complete leading-order matching onto quark and gluon operators, renormalization analysis, and systematic treatment of perturbative and hadronic-input uncertainties.

Physics Beyond the Standard Model / 64

Search for contact interactions in dilepton production from pp collisions with √s = 8 TeV using the CMS detector

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We report a search for contact interactions due to quark and lepton substructure manifest in production of μ+ μ- and e+e- pairs. The search is performed using the full data set recorded by CMS at √s = 8 TeV corresponding to integrated luminosity of 20.6 fb-1 for dimuons and 19.6 fb-1 for dielectrons. The dilepton yields for invariant masses above 300 GeV are found to be consistent with standard model Drell-Yan production. The yields are compared to those predicted by the left-left isoscalar model of contact interactions for the cases of destructive and constructive interference with standard model Drell-Yan production. Lower limits are set on the contact interaction energy scale parameter for the μ+ μ- and e+e- channels separately, and for the channels combined.

Physics Beyond the Standard Model / 65

The search for the electroweak production of supersymmetric particles in events with two leptons and missing energy at ATLAS

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The search for the electroweak production of supersymmetric particles decaying into final states containing two leptons and missing energy was performed using the full 8 TeV dataset of proton-proton collisions recorded using the ATLAS experiment. The scenarios considered in this analysis were the production of two gauginos and slepton pair production. In both of these scenarios, the supersymmetric particles were allowed to decay via R-parity conserving interactions to the lightest neutralino.

Physics Beyond the Standard Model / 177

Search for pair production of new heavy quarks that decay to a Z boson and a third generation quark in pp collisions at \sqrt{s} = 8 TeV with the ATLAS detector at the LHC

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We search for the pair production of a new heavy quark,
assuming the new quark has a significant branching ratio to decay into a Z boson and a Standard Model top (t) or bottom (b) quark.
For a new bottom-like quark B, we focus on the decay channel B \rightarrow Zb; for a new top-like quark T, we target the decay channel T \rightarrow Zt. The search uses a dataset corresponding to 14.3 fb^{-1} of pp collisions at \sqrt{s} = 8 TeV recorded
in 2012 with the ATLAS detector at the CERN Large Hadron Collider.
The signature is a high transverse momentum Z boson, decaying to light leptons, at least two jets possessing properties consistent with the hadronization of a b quark, and a large total transverse momentum of all central jets in the event. The results of the search are interpreted in the context of models with vector-like quarks (VLQ), where both chiralities have the same transformation properties under the electroweak gauge group.

Physics Beyond the Standard Model / 251

Search for gluino-mediated bottom- and top-squark production in all hadronic and single lepton multijet final states from pp collisions at sqrt(s) = 8 TeV using the CMS detector

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Two searches for gluino-mediated supersymmetry are presented based on events with large missing transverse energy and multiple jets, with some of the jets being identified as a bottom-quark jet. These searches cover two separate final states, one containing exactly zero isolated leptons, and the other containing exactly one isolated muon or electron. Both searches have been performed using proton-proton collision data corresponding an integrated luminosity of 19.4 fb^-1 recorded at a center-of-mass energy of 8 TeV with the CMS detector at the LHC in 2012. The observed numbers of events are found to be consistent with the standard model expectation. Thus, exclusion limits on new physics are evaluated for simplified supersymmetric scenarios in which gluino pair production is followed by the decay of each gluino to an undetected lightest supersymmetric particle and either a bottom or top quark-antiquark pair, based on the production cross section calculated to next-to-leading-order plus next-to-leading-logarithm accuracy.

Physics Beyond the Standard Model / 254

Search for new physics in events with same-sign dileptons and jets in pp collisions at sqrt(s) = 8 TeV

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A search for new physics is performed using events with same-sign isolated leptons and jets in the final state. The results are based on the full sample of proton-proton collisions at a center-of-mass energy of 8 TeV with the CMS detector and corresponding to an integrated luminosity of 19.5 fb-1. In order to be sensitive to a wide variety of possible signals beyond the Standard Model, we consider multiple search regions defined by the missing transverse energy, the hadronic energy, the number of jets and b-tagged jets, and the transverse momenta of the leptons in the events. The results are interpreted in a variety of new physics models. Finally, information on acceptance and efficiencies are provided so that the results can be used to confront additional models in an approximate way.

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The Heavy Photon Search Experiment at Jefferson Lab

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The Heavy Photon Search (HPS) is a new experiment at Jefferson Lab which will search for heavy $U(1)$ vector bosons (heavy/dark photons) in the mass range of 20 MeV/c^2 to 1 GeV/c^2. Dark photons in this mass range are theoretically favorable and may mediate dark matter interactions. The dark photon couples to electric charge through kinetic mixing with the photon, allowing its production through a process analogous to bremsstrahlung radiation. HPS will utilize this production mechanism to probe dark photons with relative couplings of α'/$\alpha \sim$ 10^{-5} to 10^{-10} and search for the $e^{+}e^{-}$ or $\mu^{+}\mu^{-}$ decay of the dark photon via two signatures (invariant mass and displaced vertex). Using Jefferson Lab's high luminosity electron beam along with a compact large acceptance forward spectrometer consisting of a silicon vertex tracker, lead tungstate electromagnetic calorimeter and a muon detector, HPS will access hitherto unexplored regions in the mass/coupling space. This talk will review the motivations driving the searches for dark photons and give an overview of the HPS experiment.

Physics Beyond the Standard Model / 182

Predictions of a fundamental statistical picture

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The present talk is based on arXiv:1101.0586 [hep-th], with some clarifications and additions, and a greater emphasis on the connection to standard physics. There has always been a remarkably close relationship between the partition function of statistical physics and the path integral of field theory. Here we argue that this is no coincidence, and that nature can be interpreted as a statistical system described by a Euclidean path integral (partition function), but with an action (entropy or free energy) which has Lorentzian form to lowest order. One can then transform to a Lorentzian path integral, Lorentzian propagators, etc., and the fields, operators, classical equations of motion, quantum transition probabilities, propagation of particles, and meaning of time are the same in both formulations. A specific system will be discussed which implies the following: (1) Lorentz invariance is an extremely good approximation at normal energies, but is ultimately broken at high energy. (2) Supersymmetry is inescapable. In other words, the present theory cannot possibly be formulated without susy. (3) Higgs-like bosons are inescapable. (4) The fundamental gauge theory must be SO(N), with SO(10) giving neutrino masses plus the standard model. (5) The usual cosmological constant is zero, but there is a much weaker term involving a factor that is conventionally taken to be constant. (These two points were already made in an earlier version, hep-th/9612041, before the discovery of dark energy.) The fundamental formulation of the theory also accounts for the origin of boson and fermion fields, and of spacetime coordinates, with a gravitational metric necessarily having the form (-,+,+,+). In short, the present theory is far more ambitious than string theory, and also far closer to experiment. However, the deviations from standard physics are subtle and hard to test, and quantitative predictions will also be very difficult because they require a detailed treatment of symmetry-breakings in the early universe, and of the resulting very complex vacuum fields that determine, e.g., the gravitational and gauge coupling constants plus Yukawa couplings.

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ATLAS searches for vector-like quarks in the one-lepton channel and status of global search program

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Despite observations by the ATLAS and CMS experiments of a new particle consistent with the Standard Model Higgs boson, the mechanism of electroweak symmetry breaking remains undetermined. Further, the question of naturalness remains open. Supersymmetry provides elegant insights into these problems, but so far no evidence of such signals has been found. An alternative class of models are those in which electroweak symmetry is broken dynamically by a new strong interaction, such as in Topcolor, Little Higgs, and Composite Higgs models. A recurring feature of these models is the prediction of vector-like quarks, defined as quarks for which both chiralities have the same transformation properties under the electroweak gauge group. This talk focuses on two ATLAS searches in the single lepton channel with 8 TeV data, and also reviews these results in the context of the other ATLAS searches for vector-like quarks. Each of the four searches targets a particular vector-like quark decay mode, covering both charged and neutral current modes.

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Searches for new physics in high-mass ditau events at ATLAS

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"The LHC has brought a new level of sensitivity to TeV-scale new physics. Tau leptons can have preferred couplings to possible new physics, including Z' bosons motivated by grand unified theories. Hadronic tau decays are one of the most difficult final states to identify at hadron colliders like the LHC. ATLAS has multivariate techniques for identifying hadronic tau decays using Boosted Decision Trees and sophisticated calibrations. Tau final states give complex multijet and electroweak background compositions that require data-driven techniques. Results will be presented from searches for Z' bosons in high-mass ditau events at ATLAS."

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The PIENU experiment at TRIUMF: a sensitive probe of new physics

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The PIENU experiment at TRIUMF aims to perform a precision measurement of the branching ratio of the helicity-suppressed pion decay, R = $\Gamma (\pi^+ \to e\nu + \pi^+ \to e\nu\gamma)/\Gamma (\pi^+ \to \mu\nu + \pi^+ \to \mu\nu\gamma)$. This ratio provides the most stringent test of the lepton-muon universality within the Standard Model and is currently predicted by the Standard Model to a precision of 0.01\%. PIENU aims to reach an experimental precision
of 0.1\% (more than a factor of 5 improvement over the previous experimental result) and would either confirm the Standard Model or herald the presence of new physics beyond it. The experiment finished taking data and the status of the data analysis will be presented.

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Charge and Colour Breaking Constraints in the Minimal Supersymmetric Standard Model

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The scalar potential of the Minimal Supersymmetric Standard Model (MSSM) admits the existence of vacua with non-vanishing expectation values of electrically and colour charged fields. If such minimima are deep enough, the physical electroweak vacuum is rendered unstable by quantum tunneling. By comparing the lifetime of the electroweak vacuum with the age of the universe, the MSSM parameter space can be constrained. Furthermore, the appearance of charge and colour breaking minima associated with the stop sector is strongly correlated with the Higgs mass, which has been recently measured at the Large Hadron Collider. We carry out a metastability analysis in the stop sector of the MSSM, improving upon previous results.
We exclude parts of the parameter space allowed by the Higgs mass measurement.

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Update of the same-sign dimuon asymmetry from the D0 experiment

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The DO Collaboration has published three measurements of the like-sign dimuon charge asymmetry in p pbar collisions at the Fermilab Tevatron collider. The result is significantly different from the standard model prediction. In this talk we present the final measurement of this CP violating asymmetry, using the full 10 fb-1 of data collected during Run II, and discuss its possible interpretations.

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Dark Radiation and Decaying Matter

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Recent cosmological measurements favors additional relativistic energy density beyond the one provided by the three active neutrinos and photons of the Standard Model(SM), suggesting the need of new light states in the theory beyond those of the SM. Another alternative is that this increase comes from the decay of some new form of heavy matter into the SM neutrinos. In this talk I will present the results of the cosmological data analysis for the second possibility studying the decaying matter density and it's lifetime using data from the Wilkinson Microwave Anisotropy Probe, the South Pole Telescope, measurements of the Hubble constant at present time, the results from high-redshift Type-I supernovae, the information on the Baryon Acoustic Oscillation scale, and the constraint on the expansion rate from Big Bang Nucleosynthesis.

Physics Beyond the Standard Model / 118

Study of radiative and electroweak penguin B decays at BaBar

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We report on studies of flavor-changing neutral current decays of B mesons, recently performed using the large data set collected with the BaBar detector. Sensitivity to New Physics is tested through measurements of decay rates, rate asymmetries, and CP asymmetries, in several b -> s gamma, b -> s l+l-, b -> d gamma, and b -> d l+l- processes, as well as B -> K(*) nu anti-nu decays.

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Search for Gamma-ray Spectral Lines with the Fermi Large Area Telescope and Dark Matter Implications

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There is overwhelming evidence that non-baryonic dark matter constitutes ~27% of the energy density of the universe. Weakly Interacting Massive Particles are promising dark matter candidates that may produce monochromatic gamma rays via annihilation or decay. Such interactions would produce a narrow spectral line in the Galactic diffuse gamma-ray energy spectrum. We have searched for spectral lines in the energy range 5--300 GeV using 3.7 years of data, reprocessed with updated instrument calibrations and an improved energy dispersion model compared to the previous Fermi-LAT Collaboration line searches. We searched in five regions selected to optimize sensitivity to different theoretically-motivated dark matter density distributions. We did not find any globally significant lines in our a priori search regions and will present 95% confidence limits for WIMP annihilation cross sections and decay lifetimes. We will also discuss potential systematic effects in this search and why the significance of the line-like feature near 130 GeV is less than reported in other works.

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Search for Light- and Heavy-flavor Three-jet Resonances in Multijet Final States

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A search for three-jet hadronic resonance production in pp collisions at a center-of-mass energy of 8 TeV using 19.5/fb of data collected by the CMS experiment in 2012 is presented. The search method is model-independent for events with high jet multiplicity and large sum jet pT; however, event selection is optimized using an R-parity-violating supersymmetric model with gluino pair production in a six-jet final state. The search includes a model where the gluino decays only to light-flavor jets and one that allows decays to a b jet and two light-flavor jets. The analysis technique is validated by a known hadronic resonance, the top quark.

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Possible Advances in Computing

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View from Europe

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View from Asia

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Agency Discussion of Next Steps

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Particle Physics from Cosmic Surveys

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Other Cosmic Frontier Projects

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Possible Advances in Detectors

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Novel Accelerators: Building a Physics-Producing Machine

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EWSB and the Higgs Sector

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New Physics Searches

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What have we learned at the Energy Frontier?

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Evolution of the LHC program

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What have we learned from Flavor Physics experiments?

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UCSC Welcome

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Cosmic Frontier

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Neutrino Physics

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Top Quark and Electroweak Physics

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Plenary Session / 30

Physics using the 5 Lighter Quarks and Charged Leptons

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Summary of Advances in Theoretical Physics

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Tanaka Award

MOORE, David [1]

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Closing Remarks from DPF Chair

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Projects in Flavor Physics

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Possibilities for Neutrino Physics

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Possible Dark Matter Projects

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Results from other areas of the Cosmic Frontier

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Studies for Dark Energy

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Status of Searches for Dark Matter

Plenary Session / 5

What have we learned from Neutrinos?

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Possibilities for lepton colliders

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Poster Session / 281

Readout Control for the Upgraded Readout Architecture of the LHCb experiment at CERN

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The LHCb experiment at CERN has proposed an upgrade towards a full 40 MHz readout system in order to run between five and ten times its initial design luminosity with an upgraded LHCb detector. As a consequence, the various LHCb sub-systems in the readout architecture will be upgraded to cope with higher sub-detector occupancies, higher rate, and higher readout load. The new architecture, new functionalities, and the first hardware implementation of a new LHCb Readout Control system (commonly referred to as S-TFC) for the upgraded LHCb experiment is here presented. Our attention is focused in describing solutions for the distribution of clock and timing information to control the entire upgraded readout architecture by profiting of a bidirectional optical network and powerful FPGAs, including a real-time mechanism to synchronize the entire system. Solutions and implementations are presented, together with first results on the simulation and the validation of the system.

Poster Session / 285

The Fast TracKer Upgrade to the ATLAS Detector

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When the LHC reaches beyond its current design luminosity, the load on the Level-2 trigger system will increase significantly due to both the need for more sophisticated
algorithms to suppress backgrounds and the larger event sizes. The Fast TracKer
(FTK) is a custom electronics system that will operate at the full Level-1
accepted rate of 100 KHz and provide high quality tracks at the beginning of
processing in the Level-2 trigger, by performing track reconstruction in hardware
with massive parallelism of associative memories (AM) and FPGAs.

The latest performance results in important physics for high luminosity LHC running
areas will be presented using data from the ATLAS
Monte Carlo simulation at different LHC luminosities. An overview of the system design and the status of R of individual components will be presented. Related technologies, such as AM chip and Advanced Telecommunications Computing Architecture (ATCA), will be discussed.

Poster Session / 284

Cathode Strip Chamber upgrade for the CMS Endcap at the HL-LHC

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The High Luminosity LHC accelerator upgrade will provide five times higher instantaneous luminosity than the current LHC. This boost in luminosity will allow the Compact Muon Solenoid (CMS) experiment to probe the properties of the newly discovered Higgs boson and extend the search for new physics beyond the Standard Model. In order to handle the increased data rate and maintain high trigger efficiency for pseudorapidity up to 2.4, the readout and trigger electronics of the Cathode Strip Chamber (CSC) muon detectors in the CMS endcap are undergoing an upgrade. This talk will discuss the design of the new level-1 trigger electronics based on the new generation of FPGA technologies and fast optical links, the ongoing commissioning and system integration of new readout and trigger electronics for the ME1/1 system, as well as the results of testing for stability at high radiation levels expected in the HL-LHC environment. In conclusion, we will discuss plans for early commissioning of the system and the expected improvements in system performance.

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Potential Impact of a New GEM-Based Muon Detector on CMS Triggering

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Following the increases in the LHC instantaneous luminosity, maintaining effective triggering and avoiding dead time will become especially challenging. As the sensitivity of many physics studies, including higgs measurements, depends critically on the ability to maintain relatively low muon momentum thresholds, the identification of potential improvements in triggering is particularly important. We show that the addition of a new muon detector with high spatial resolution to the existing CMS muon system in the very forward region, where the background rates are especially high, allows for a substantial improvement in the performance of muon triggering. Integration of the new detector and the existing Cathode Strip Chamber system allows for a substantial improvement in muon trigger momentum resolution due to an increase in the lever arm for the measurement of the muon bending angle. We demonstrate that a detector based on triple GEM chambers is an excellent candidate for maintaining efficient muon triggering at CMS, owing to its high spatial precision and the ability to operate in the high rate environment of the very forward region.

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LHCb High Level Trigger design issues for post Long Stop 1 running

Dr. ALBRECHT, Johannes [1]; Dr. GLIGOROV, Vladimir [2]; Prof. RAVEN, Gerhard [3]; WILLIAMS, Mike [4]; Prof. SOKOLOFF, Michael [5]

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The LHCb High Level Trigger uses two stages of software running on an Event Filter Farm (EFF) to select events for offline reconstruction and analysis. The first stage (Hlt1) processes approximately 1 MHz of events accepted by a hardware trigger. In 2012, the second stage (Hlt2) wrote 5 kHz to permanent storage for later processing. Following the LHC's Long Stop 1 (anticipated end date 2015), the machine energy will increase from 8 TeV in the center-of-mass to 13 TeV and the cross sections for beauty and charm are expected to grow proportionately. We plan to increase the Hlt2 output to 12 kHz, some for immediate offline processing, some for later offline processing, and some ready for immediate analysis. By increasing the absolute computing power of the EFF, and buffering data for processing between machine fills, we should be able to significantly increase the efficiency for signal while improving signal-to-background ratios. In this poster we will present several strategies under consideration and some of the tools we are using to evaluate these strategies.

Poster Session / 81

Search for the Standard Model Higgs Boson in ZH(bb) where the Z Boson Decays into a tau Pair and Each tau Decays into Leptons

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A search for the standard model Higgs boson in pp collisions is presented in the associated production channel Z(tautau)H(bb) where each tau decays leptonically, one to an electron, the other to a muon. A data sample comprising of 5.0 fb-1 at center-of-mass energy 7 TeV and 19 fb-1 at center-of-mass energy 8 TeV collected by the CMS detector at the LHC has been analyzed and 95% confidence level upper limits on the production cross-section relative to the Standard Model prediction are presented for the 110-150 GeV Higgs mass range.

Poster Session / 305

The Daya Bay Reactor Neutrino Experiment: Overview and Results

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The Daya Bay Reactor Neutrino Experiment was designed to achieve a sensitivity on the value of $\sin^22\theta_{13}$ to better than 0.01 at 90\%~C.L. The experiment consists of eight antineutrino detectors installed underground at different baselines from six nuclear reactors. With data collected from six antineutrino detectors for 140 days, Daya Bay has thus far published a measurement of $\sin^22\theta_{13} = 0.089\pm0.010 \text{ (stat)}\pm0.005 \text{ (syst)}$. In this poster, we summarize the main details of the experiment, and review the most recent results to date.

Poster Session / 306

The Daya Bay Reactor Neutrino Experiment: Prospects

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The neutrino mixing angle θ_{13} is the gateway for studying CP violation in the lepton sector and determines the trend of future neutrino experiments. The Daya Bay Reactor Neutrino Experiment is designed to measure $\sin^22\theta_{13}$ to better than 0.01 at 90\%~C.L. This will be the most precise measurement of θ_{13} for the foreseeable future. In addition, the configuration of detectors at Daya Bay is well suited for addressing a broad range of topics, from cosmogenic backgrounds to supernovae. This poster will summarize the scientific goals and prospects of Daya Bay.

Poster Session / 37

Why We Need a Terascale Photon Collider to Understand Light

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Recent interest in a photon-photon collider as a possible Higgs factory has revived the question of what other physics that can be done with such machines. We demonstrate that the bb bar cross section, a large background to Higgs production at high energy photon colliders, has an uncertainty due to the resolved structure of the photon of nearly an order-of-magnitude. Hence, study of the resolved photon structure will be a compelling area of study at these machines.

Poster Session / 272

Experience Running an Analysis Cluster in an Academic Cloud

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Cloud computing offers the opportunity for small research groups with fluctuating computing needs to access significant computing power with minimal investment in hardware and administration. However the cloud environment presents its own challenges, in particular those posed by the movement and storage of the large datasets used in HEP. We have evaluated two academic Infrastructure as a Service cloud platforms (Nimbus and OpenStack) in the FutureGrid testbed at the Texas Advanced Computing Center. We report on the experience, in particular ease of use and performance.

Poster Session / 273

Natural, R-parity violating supersymmetry and horizontal flavor symmetries

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Motivated by null LHC searches for R-parity conserving SUSY, I will present the general structure of RPV couplings in presence of a Froggatt-Nielsen horizontal symmetry. For sub-TeV SUSY, lepton number must be an accidental symmetry, while baryonic RPV allows natural low-energy SUSY. The upper limit for the magnitude of the largest RPV coupling is 10^{-3} (from dinucleon decay) while the lower limit is 10^{-9} (from missing E_T SUSY and R-hadrons searches), and displaced vertices are predicted in about half of this range.

Poster Session / 274

Particle Production Measurements using the MIPP Detector at Fermilab

Ms. MAHAJAN, Sonam [1]; Dr. RAJA, Rajendran [2]

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The Main Injector Particle Production (MIPP) experiment at Fermilab is a fixed target hadron production experiment. It measures particle production in interactions of 120 GeV/c primary protons from the Main Injector and secondary beams of $\pi^{\pm}, \rm{K}^{\pm}$, p and $\bar{\rm{p}}$ from 5 to 90 GeV/c on nuclear targets which include H, Be, C, Bi and U, and a dedicated run with the NuMI target. MIPP is a high acceptance spectrometer which provides excellent charged particle identification using Time Projection Chamber (TPC), Time of Flight (ToF), multicell Cherenkov (CKOV), Ring Imaging Cherenkov (RICH) detectors, and Calorimeter for neutrons. We present inelastic cross section measurements for 58 and 85 GeV/c p-H interactions, and 58 and 120 GeV/c p-C interactions. A new method is described to account for the low multiplicity inefficiencies in the interaction trigger using KNO scaling. Inelastic cross sections as a function of multiplicity are also presented. The MIPP data are compared with the Monte Carlo predictions and previous measurements. We also describe an algorithm to identify charged particles ($\pi^{\pm}/\rm{p}/\bar{\rm{p}}$ etc.), and present the charged pion and kaon spectra from the interactions of protons with H, C and NuMI targets for both the data and Monte Carlo.

Poster Session / 275

MINERvA Charged Current Inclusive Analysis

Mr. MARTINEZ, David [1]

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MINERvA is a few-GeV neutrino scattering experiment that has been taking data in the NuMI beam line at Fermilab since November 2009. The experiment will provide important inputs, both in support of neutrino oscillation searches and as a pure weak probe of the nuclear medium. For this, MINERvA employs a fine-grained detector, with an eight ton active target region composed of plastic scintillator and a suite of nuclear targets composed of helium, carbon, iron, lead and water placed upstream
of the active region. In this talk, we present the current status of the charged current inclusive analysis in the plastic scintillator.

Poster Session / 276

Data Driven Triggers for the NOvA Experiment

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The NOvA experiment has an 810 km long baseline and uses the upgraded NuMI neutrino beam from Fermi National Accelerator Laboratory to study neutrino oscillation parameters. The two fully active, functionally identical detectors are placed 14 milliradians off axis to access a narrow neutrino energy spectrum, due to the pion decay kinematics. The 300 ton near detector, located at Fermilab, is dwarfed by the 14 kton far detector at Ash River, MN and will be the largest free standing plastic structure in the world.

A data driven trigger framework has been developed to aid in achieving the physics goals of NOvA. It has been implemented as an alternative trigger path to the timing trigger of beam spills, as well as the gateway to explore physics unrelated to beam neutrinos. The data acquisition of the detector has a continuous readout enabling this trigger framework to record zero biased data. It has many commonalities to our analysis framework, handling the data stream in pseudo-real time, to ease the development by our collaborators. The status of several triggers as well as other proposed applications will be presented.

Poster Session / 277

The Heavy Photon Search Experiment at Jefferson Lab

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The Heavy Photon Search (HPS) is a new experiment at Jefferson Lab which will search for heavy $U(1)$ vector bosons (heavy/dark photons) in the mass range of 20 MeV/c^2 to 1 GeV/c^2. Dark photons in this mass range are theoretically favorable and may mediate dark matter interactions. The dark photon couples to electric charge through kinetic mixing with the photon, allowing its production through a process analogous to bremsstrahlung radiation. HPS will utilize this production mechanism to probe dark photons with relative couplings of α'/$\alpha \sim$ 10^{-5} to 10^{-10} and search for the $e^{+}e^{-}$ or $\mu^{+}\mu^{-}$ decay of the dark photon via two signatures (invariant mass and displaced vertex). Using Jefferson Lab's high luminosity electron beam along with a compact large acceptance forward spectrometer consisting of a silicon vertex tracker, lead tungstate electromagnetic calorimeter and a muon detector, HPS will access hitherto unexplored regions in the mass/coupling space. This talk will review the motivations driving the searches for dark photons and give an overview of the HPS experiment.

Poster Session / 278

High Energy Physics instrumentation activities at LBNL for the ATLAS tracker upgrades of the LHC

Dr. DIEZ-CORNELL, Sergio [1]; Dr. HABER, Carl [1]

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Lawrence Berkeley national Laboratory (LBNL) is a renowned institution in High Energy Physics research and instrumentation development. The ATLAS group of the Physics Division has been deeply involved in the construction, installation, and operation of the ATLAS detector at the LHC. This paper describes the instrumentation activities in which the group is currently involved regarding the forthcoming upgrades of the ATLAS tracker, including the silicon pixel and strip sub-detectors.

Poster Session / 279

UltraSiD, a novel 4D Sensor Concept

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We propose to develop a fast, thin silicon sensor with gain capable to concurrently measure with high precision the space
(~10 μm) and time (~10 ps) coordinates of a particle.
An integral part of the proposed sensors is the internal charge multiplication in silicon sensors, allowing to thin pixelated silicon sensors by at least a factor 10 and keeping the performance of thick sensors.
This will open up new application of silicon detector systems in many fields achieve four-dimensional high-precision
measurements. The basic sensor characteristics and the expected performance, the present status of sensors and readout electronics will be presented and the required R topics will be discussed.

Poster Session / 280

Wireless Power and Data Acquisition System for Large Instrumentation Systems

Dr. SAHOO, Himansu [1]; Dr. DE LURGIO, Patrick [1]; Dr. DJURCIC, Zelimir [1]; Dr. DRAKE, Gary [1]; Dr. KREPS, Andrew [1]; Dr. OBERLING, Michael [1]; Prof. HASHEMIAN, Reza [2]; Mr. PEARSON, Timothy [2]

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I will present the development of a new prototype wireless data acquisition system with the intended application to read-out
instrumentation systems having thousands of channels. The data acquisition and control is based on a compliant implementation of 802.11 based
hardware and protocols. Our case study is for large detectors containing photomultiplier tubes. We have explored both free-space optical and radio frequency options for wireless power transfer. The front-end circuitry, including a high-voltage power supply is powered wirelessly thus creating an all-wireless detector readout.
We have successfully tested the system as a single detector module that is power wirelessly and then sends data wirelessly. I will cover the performance of this all-wireless prototype system and how a large scale implementation of the system might be realized.

Public Lecture by Hitoshi Murayama: "The Quantum Universe" / 311

The Quantum Universe

QCD Physics / 214

Bounding the Higgs Boson Width Through Interferometry

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We study the change in the di-photon invariant mass distribution for Higgs boson decays to two photons, due to interference between the Higgs resonance in gluon fusion and the continuum background amplitude for gluon pair to photon pair. Previously, the apparent Higgs mass was found to shift by around 100 MeV in the Standard Model in the leading order approximation, which may potentially be experimentally observable. We compute the next-to-leading order QCD corrections to the apparent mass shift, which reduce it by about 40%. The apparent mass shift may provide a way to measure, or at least bound, the Higgs boson width at the Large Hadron Collider through "interferometry". We investigate how the shift depends on the Higgs width, in a model that maintains constant Higgs boson signal yields. At Higgs widths above 30 MeV the mass shift is over 200 MeV and increases almost linearly with the width. The apparent mass shift could be measured by comparing with the ZZ* channel, where the shift should be much smaller. It might be possible to measure the shift more accurately by exploiting its strong dependence on the Higgs transverse momentum.

QCD Physics / 215

A Laplace Sum-Rules Analysis of Exotic 0^{+-} and Vector 1^{--} Strangeonium Hybrids

Mr. BERG, Ryan [1]; Dr. HARNETT, Derek [2]; Dr. STEELE, Tom [1]

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[2] University of the Fraser Valley

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We use QCD Laplace sum-rules to predict ground state masses for $J^{PC}=0^{+-}$ and $J^{PC}=1^{--}$ strangeonium hybrids. In our calculations, we include contributions stemming from perturbation theory, 4d quark and gluon condensates, the 5d mixed condensate, and 6d quark and gluon condensates. These two J^{PC}-channels are of particular phenomenological interest as the Y(2175) has quantum numbers 1^{--}, and 0^{+-} is one of the exotic combinations that will be probed by GlueX.

QCD Physics / 138

How the Z_c(3900) Reveals the Spectra of Quarkonium Hybrid and Tetraquark Mesons

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Flavor-exotic tetraquark mesons have recently been observed in the heavy-quark pair sectors of QCD, including two isospin multiplets in the b b-bar sector, Z_b(10610) and Z_b(10650), and one isospin multiplet in the c c-bar sector, Z_c(3900). We identify Z_b and Z_c as tetraquark mesons that are analogs of quarkonium hybrids with the gluon field replaced by an isospin-1 excitation of the light-quark fields. Given the identification of Y(4260) and Z_c(3900) as a ground-state charmonium hybrid and tetraquark, respectively, lattice QCD calculations of the charmonium spectrum can be used to estimate the masses of the lowest four spin-symmetry multiplets of charmonium hybrids and tetraquarks. The Z_b(10610) and Z_b(10650) can be assigned to excited-state multiplets of bottomonium tetraquarks, resulting in estimates of the masses of the ground-state multiplets of bottomonium hybrids and tetraquarks.

QCD Physics / 123

Study of baryonic decays of B mesons at BaBar

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Baryonic decays account for about 7% of the B-meson width, and have been studied
in recent years by the B factories.
These studies reveal properties of hadronization at low q^2, such as s anti-s suppression
known from jet fragmentation, and phase space relations between the baryon and antibaryon.
The measurement and comparison of exclusive branching fractions of
baryonic B decays as well as studies on the dynamics of the decay,
may allow better understanding of the aforementioned properties.
We present the most recent measurements of B-meson decays with
two or four baryons in the final state performed with the BABAR detector.

QCD Physics / 126

Measurement of the proton form factor in e+e- annihilation at BaBar

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We present a study of the e+e- --> p anti-p process
using initial state radiation with BABAR. The BABAR data sample,
469 fb-1, collected at and near Y(4S) has been used to measure
the e+e- --> p anti-p cross section and the proton effective
electromagnetic form factor. The ratio of the electric and
magnetic form factors has been extracted from an analysis of the proton
angular distribution for c.m. energies below 3 GeV.
The charge asymmetry in the angular distribution has been also studied.

QCD Physics / 127

Measurement of inclusive production of light charged hadrons at BaBar

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Inclusive hadron production cross sections in
e+e- collisions shed light on fundamental questions of hadronization and
fragmentation processes. We present measurements of inclusive spectra
of various light hadrons produced in e+e- collisions at a center-of-mass energy
of about 10.5 GeV. These results help test the scaling properties of the cross
sections by comparison with previous measurements at higher center-of-mass
energies and with theoretical predictions.

QCD Physics / 59

Threshold resummation in direct photon production and its implications on large-x gluon PDF.

SATO, Nobuo [1]

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The precise knowledge of parton distribution functions at large-x is important in order to understand the production of a massive state at forward rapidities at the LHC. Currently, the gluon PDF is highly unconstrained at large-x and it is mainly constrained by jet data. In the past, direct photon production with high transverse momentum at fixed target experiments was used to constrain gluon distribution due to its dominant contribution from $qg \rightarrow\gamma q$ subprocess in proton-proton collisions. Due to inconsistencies between the theory at NLO in pQCD and the data, direct photons was excluded from global fits. This talk will discuss an improvement to the theory at NLO by including ``threshold resummation'' at NLL and its impact on gluon distribution at large-x using Bayesian reweighting technique.

QCD Physics / 55

Observation of associated W and J/psi production at ATLAS

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[2] University of Chicago

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Compared to inclusive J/psi production, the associated production of weak vector bosons and J/psi mesons in hadron collisions selects a different set of partonic initial states and provides complementary information on quarkonium production mechanisms. Using 4.6 inverse femtobarns of pp collisions at sqrt(s) = 7 TeV recorded by ATLAS, we observe and measure the rate of W+J/psi associated production, estimate the fraction due to multiple parton interactions, and compare the results with theoretical predictions of the color singlet and color octet models.

QCD Physics / 51

New approach to identifying boosted hadronically-decaying particle using jet substructure in its center-of-mass frame

Prof. CHEN, chunhui [1]

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We introduce a new approach to study jet substructure in the center-of-mass frame of the jet. We demonstrate that it can be used to discriminate the boosted heavy particles from the QCD jets and the method is complimentary to the existing other jet substructure algorithms. Applications to searches for hadronically decaying W/Z+jets, top jet and heavy resonance that decays to final states with W/Z and top jets are also discussed. The talk is based on my papers published in Physical Review D (PRD85,034007 (2012) & PRD 87, 074007 (2013)) and some recent work afterwards (to be submitted to a paper).

QCD Physics / 294

Matching NLO Calculations and Parton Showers

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Review of recent progress in matching higher order calculations and parton showers.

QCD Physics / 295

Parton Distribution Functions

Dr. NADOLSKY, Pavel [1]

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Review of recent progress on PDFs.

QCD Physics / 293

QCD at Colliders

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Review of recent higher-order QCD calculations.

QCD Physics / 85

Measurement of angular correlations of jets in pp collisions at sqrt(s) = 8 TeV with the ATLAS detector

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A measurement of angular correlations of jets in hadron collisions is presented. This measurement is sensitive to QCD dynamics and to the strong coupling constant, while being only weakly sensitive to parton distribution functions. The observable is the number of neighboring jets above a given transverse momentum threshold which accompany a given jet within a distance ΔR in the plane of rapidity and azimuthal angle. The ensemble average over all jets in an inclusive jet sample, $R_{\Delta R}$, is measured and the results are presented as a function of transverse momentum of the inclusive jets, in different regions of ΔR and for different transverse momentum requirements for the neighboring jets. The measurement is based on a data set corresponding to an integrated luminosity of 20 fb^{-1} collected with the ATLAS detector at the Large Hadron Collider in pp collisions at $\sqrt(s)=8$~TeV. The results are compared to the predictions of a perturbative QCD calculation in next-to-leading order in the strong coupling constant, corrected for non-perturbative effects.

QCD Physics / 246

Measurements of the associated production of a vector boson with jets at D0

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Studies of associated production of a W, Z or photon with jets provide important tests of perturbative quantum chromodynamics calculations. A good understanding of such processes is essential in part because they constitute a major background to the production of the standard model Higgs boson in association with a vector boson. Recent measurements of the production of a vector boson plus jets (including heavy-flavor jets) by the D0 experiment are presented. The results are compared to predictions from next-to-leading order calculations and various Monte Carlo event generators.

QCD Physics / 169

Particle Production Measurements using the MIPP Detector at Fermilab

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The Main Injector Particle Production (MIPP) experiment at Fermilab is a fixed target hadron production experiment. It measures particle production in interactions of 120 GeV/c primary protons from the Main Injector and secondary beams of $\pi^{\pm}, \rm{K}^{\pm}$, p and $\bar{\rm{p}}$ from 5 to 90 GeV/c on nuclear targets which include H, Be, C, Bi and U, and a dedicated run with the NuMI target. MIPP is a high acceptance spectrometer which provides excellent charged particle identification using Time Projection Chamber (TPC), Time of Flight (ToF), multicell Cherenkov (CKOV), Ring Imaging Cherenkov (RICH) detectors, and Calorimeter for neutrons. We present inelastic cross section measurements for 58 and 85 GeV/c p-H interactions, and 58 and 120 GeV/c p-C interactions. A new method is described to account for the low multiplicity inefficiencies in the interaction trigger using KNO scaling. Inelastic cross sections as a function of multiplicity are also presented. The MIPP data are compared with the Monte Carlo predictions and previous measurements. We also describe an algorithm to identify charged particles ($\pi^{\pm}/\rm{p}/\bar{\rm{p}}$ etc.), and present the charged pion and kaon spectra from the interactions of protons with H, C and NuMI targets for both the data and Monte Carlo.

QCD Physics / 73

Threshold Resummation and Determinations of Parton Distribution Functions

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The precise knowledge of parton distribution functions (PDFs) is indispensable to the accurate calculation of hadron-initiated QCD hard scattering observables. Much of our information on PDFs is extracted by comparing deep inelastic scattering (DIS) and lepton pair production (LPP) data to convolutions of the PDFs with the partonic cross sections of these processes. It is known that partonic cross sections receive large corrections in regions of phase space near partonic thresholds that can be resummed using threshold resummation techniques. The effect of threshold resummation on DIS and LPP differs because partonic thresholds for the two processes occur in different kinematic regions. Recent global fits for PDFs have included DIS data from the large Bjorken x and moderate Q^2 region where threshold effects have been shown to be large. The present project explores the effects of simultaneously incorporating threshold resummation in both DIS and LPP and to evaluate the effects of such additions on global fits. The status of the progress to date will be reviewed.

QCD Physics / 154

Progress Towards the First Measurement of Direct CP-Violation in K->pi pi Decays From First Principles

Dr. KELLY, Christopher [1]; Prof. CHRIST, Norman [1]; Dr. LEHNER, Christoph [2]; Dr. LYTLE, Andrew [3]; Prof. MAWHINNEY, Robert [1]; Prof. SACHRAJDA, Christopher [4]; Dr. SONI, Adler [2]; Mr. ZHANG, Daiqian [1]; Prof. THOMAS, Blum [5]; Dr. BOYLE, Peter [6]; Dr. JULIEN, Frison [6]; Dr. GARRON, Nicolas [7]; Dr. IZUBUCHI, Taku [8]

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[3] Tata Institute of Fundamental Research

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[5] University of Connecticut / RIKEN-BNL Research Center

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Direct CP-violation was first observed in the late 1990s in K->pi pi decays, and precise experimental measurements have since been made. However until recently it has not been possible to calculate its measure directly from the Standard Model due to it receiving large contributions from QCD in the hadronic regime in which perturbation theory is not applicable. This is unfortunate because these decays are highly sensitive to BSM sources of CP violation, and a comparison with the experimental result may lead to the discovery of new physics. Now, using lattice QCD, and combining decades of theoretical and computational developments, such a calculation has become feasible.

The RBC & UKQCD collaborations have recently published the first calculation of the K->pi pi decay amplitude in the I=2 channel. I will discuss the techniques used for this calculation and then describe our progress towards the more difficult task of measuring the decay in the I=0 channel, which represents the last hurdle before a full ab initio value for the measure of direct CP-violation can be obtained.

QCD Physics / 2

Charmonium and Bottomonium Hybrid States

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We have calculated the correlation functions of heavy quarkonium hybrid operators with various J^{PC} quantum numbers to include QCD condensates up to dimension six.
As observed before, the dimension six condensates could stabilize the hybrid sum rules
and permit reliable mass predictions. After performing the QCD sum rule analysis, we
extract the masses of charmonium and bottomonium hybrids with exotic and non-exotic quantum numbers. We have confirmed the supermultiplet structures of the hybrid states
predicted in the MIT bag model. We identify that the negative-parity states with $J^{PC}=(0, 1, 2)^{-+}, 1^{--}$ form the lightest hybrid supermultiplet while the positive-parity states with $J^{PC}=(0, 1)^{+-}, (0, 1, 2)^{++}$ form a heavier hybrid supermultiplet. The mass of the hybrid with $J^{PC}=0^{--}$ is very high, which may suggest a different excitation of the gluonic field compared to other channels.

QCD Physics / 262

Photon Results from CDF

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The CDF Collaboration continues to analyze the complete, legacy
dataset of approximately 10 fb-1. This report will cover
several recent analyses which feature high-energy photons.
QCD hard interactions and proton structure can be probed by
comparing measurements of photon cross sections to state-of-the-art
calculations. We will report cross section measurements for events
with two photons and for events with a photon and heavy-flavor quark.
In addition, the latest photon analysis available will be reported.

QCD Physics / 41

Evidence for a bottom baryon resonance state Lambda_b* with the CDF II detector

Mr. PALNI, Prabhakar [1]

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Using data from proton-antiproton collisions at center of mass energy of 1.96 TeV recorded by the CDF II detector at the Fermilab Tevatron, evidence for the excited resonance state Lambda_b* is presented in its fully reconstructed decay mode to Lambda_b0 pi+ pi- where Lambda_b0 decays to Lambda_c+ pi- with Lambda_c+ decays to p K- pi+. The analysis is based on a data sample corresponding to an integrated luminosity of 9.6 fb^-1 collected by an online event selection based on charged-particles' tracks displaced from the proton-antiproton interaction point. The significance of the observed signal is 3.5 sigma. The mass of the observed state is found to be 5919.22 ± 0.35 (stat) ± 0.30 (syst) ± 0.70 (PDG) MeV/c^2 in agreement with similar findings in proton-proton collisions experiments.

QCD Physics / 47

Onia production and polarisation at LHCb

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Studies of quarkonia production in the forward region provide important tests of NRQCD. The LHCb experiment has collected a dataset corresponding to an integrated luminosity of about 3 fb-l in proton-proton collisions at sqrt(s)= 7 and 8 TeV. We present studies of the production and polarisation of the J/psi, psi(2S) and chi_c charmonium states as well as those of Upsilon and chi_b bottomonia. Absolute and relative production cross-sections are presented and compared to the most recent theoretical predictions when available. We also discuss the future prospects for these measurements.

Quark and Lepton Flavor Physics / 132

The Mu2e Experiment At Fermilab

Dr. KUTSCHKE, Rob [1]

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The Mu2e experiment at Fermilab will search for coherent, neutrino-less conversion of muons into electrons in the Coulomb field of a nucleus with an improvement in sensitivity of a factor of 10,000 over existing limits. Such a lepton flavor-violating reaction probes new physics at a scale inaccessible with direct searches at either present or planned high
energy colliders. The experiment both complements and extends the current studies at MEG and at the LHC. I will present the physics motivation for Mu2e, as well as the design of the muon beamline, tracking spectrometer, and calorimeter. I will also discuss the evolution of the current Fermilab Muon Charged Lepton Flavor Violation Program into the Project X era.

Quark and Lepton Flavor Physics / 137

Measurements of b hadron lifetimes and effective lifetimes at LHCb

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Precision measurements of b-hadron lifetimes are a key goal of the LHCb experiment. In the Bs0 sector, the measurement of the effective lifetimes for Bs0 mesons decaying to CP-odd, CP-even and flavor specific final states are essential for constraining the Bs0 mixing parameters, ΔΓs, the average width Γs and the CP-violating phase, φs. Measurements of b baryon lifetimes are also important to test theoretical models. We present the latest results from LHCb on these topics.

Quark and Lepton Flavor Physics / 120

Mixing-induced CP Asymmetry in semileptonic B-meson decays at BaBar

BABAR SPEAKER (% FRANK PORTER), na [1]

[1] na

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We present the measurements of mixing-induced CP asymmetry in semileptonic B-meson decays using the full data set collected at the peak of the Y(4S), with the BABAR detector at SLAC. The lepton charge directly identifies the B meson flavor in decays; charged kaons are also used in tagging B meson flavor. Asymmetry between B meson pairs decaying as B0-B0 and B0bar-B0bar indicates CP violation in mixing.

Quark and Lepton Flavor Physics / 121

B -> omega omega, omega phi, CP violation in B to three kaons, and other charmless B-meson decays

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The B decays to omega omega and omega phi are related to B -> phi K* via an SU(3) rotation. The study of these yet unseen decay modes can therefore provide information regarding the unexpectedly small value of the longitudinal spin component (f_L) measured in B -> phi K* decays. We present here the results of a new search for these decay modes, as well as other charmless B decays, performed using about 470M B-Bbar events recorded by the BaBar detector. We also present studies of direct CP violation in charmless B decays to kaons. In particular we discuss the K+K- mass dependence of the CP-asymmetry of the decay B+ --> K+K-K+.

Quark and Lepton Flavor Physics / 124

Precision measurement of the D0 mass and of the natural line width of the D*+

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We present the measurement of the mass of the D0 meson, the D*(2010)+ natural line width, and the mass difference between the D*(2010)+ and the D0 mesons using pure samples of D*(2010)+ --> D0 pi+ decays. The measurements are based on a data sample corresponding to an integrated luminosity of about 477 fb-1, collected with the BaBar detector. Large improvements with respect to the existing measurements have been obtained for all the measured quantities.

Quark and Lepton Flavor Physics / 128

Measurements of tau hadronic branching fractions and spectra, and search for second class current tau decays

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We present a set of preliminary and final results on tau branching fractions
and invariant mass spectra, and a search for the second class current decay
tau -> pi eta'(958) nu_tau.
The results include new studies of a large number of 3 and 5-prong tau decay modes,
either inclusive or classified according the hadronic resonance content (K0S, eta,
omega, etc.).
All results are based on the analysis of the BaBar data-set consisting
of 430 million tau lepton pairs, corresponding to an integrated luminosity of 468 fb^-1,
collected with the BABAR detector at the PEP-II asymmetric energy e+ e- storage rings.

Quark and Lepton Flavor Physics / 236

The serch for Bs-> mumu at D0

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We present a search for the rare decay Bs-> mu mu in the D0 detector. All results are based on the full D0 data set of 10.4 fb-1 of integrated luminosity.

Quark and Lepton Flavor Physics / 56

Studies of charm mixing and CP violation at LHCb

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LHCb has collected the world's largest sample of charmed hadrons. This sample is used to search for direct and indirect CP violation in charm, and to measure D0 mixing parameters. Preliminary measurements from several decay modes are presented, with complementary time-dependent and time-integrated analyses.

Quark and Lepton Flavor Physics / 52

Studies of the electroweak penguin transitions and radiative B decays at LHCb

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Rare b⟶sμ+μ− transitions that proceed via flavour changing neutral currents are suppressed in the SM and provide a sensitive probe of new physics contributions entering in competing diagrams. The dataset collected with the LHCb experiment has enabled measurements to be made in decays such as B⟶K*0μ+μ−, B+⟶K+μ+μ− and Bs⟶φμ+μ−. Particularly interesting are the angular and isospin asymmetries in the decay B⟶K(*)0μ+μ−, which are sensitive probes of new physics. The large statistics of reconstructed B mesons allow, for the first time, experimental access to b⟶dμ+μ− transitions, such as B+⟶π+μ+μ−, which are further suppressed in the SM. Radiative B decays are also sensitive probes of New Physics. We present the latest results on these decays from the LHCb experiment. Results include first measurements of new decay modes and studies that are sensitive to physics beyond the Standard Model that may affect the polarisation of the emitted photon in radiative B decays.

Quark and Lepton Flavor Physics / 200

Belle II (construction, commissioning and prospects)

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We report on the construction and
plans for initial operation of Belle II and SuperKEKB.
The new facility will be an upgrade of the
existing KEKB electron-positron collider,
with a target luminosity of
8 x 10^{35} /cm^2/s - about 40 times greater than that of KEKB.
The Belle II detector will study rare flavor physics
processes with unprecedented
sensitivity for indirect (virtual-particle)
contributions from as-yet unexplored phenomena at the TeV scale.

Quark and Lepton Flavor Physics / 193

LYSO Crystal Calorimeter in the Mu2e Experiment

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Mu2e is a new experiment planned at Fermilab to study charged lepton flavor violation in muon to electron conversion in presence of a nucleus. Muons produced by 8-GeV protons on target are captured by an aluminum target and, if converting to an electron, generate a
signal of a 105 MeV monoenergetic electron. Mu2e is designed to reach a sensitivity of a few times 10^{-17} in the ratio of mu-e conversion to conventional muon capture rate in Al. Electrons are detected by a straw tube tracker and a calorimeter placed inside a detector solenoid covered by a cosmic ray veto system. The calorimeter consists of arrays of approximately 2000 crystals. LYSO is chosen for its short decay time, high light yield, and radiation hardness. The calorimeter provides the confirmation of the electron energy, timing, and position, a strong muon background rejection, as well as an independent trigger. The proposed design, efficiency and resolution studies, and beam test results are presented.

Quark and Lepton Flavor Physics / 110

|Vub| from semileptonic B decays at BaBar

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We report on recent BaBar results for the CKM matrix element |Vub| using
both inclusive and exclusive measurements of charmless semileptonic B decays.
These include the measurement of exclusive B -> pi/eta/eta'/omega l nu decays
with untagged event reconstruction and the study of the q^2 and lepton energy
distribution in inclusive B -> Xu l nu.

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Use of B->J/psi f0 decays to discern the q anti-q or tetraquark nature of scalar mesons

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We consider the relative decay rates of B0 and Bs mesons into a J/psi plus a light scalar meson either the f0(500) (\sigma) or the f0(980). We show that it is possible to distinguish between the quark content of the scalars being quark-antiquark or tetraquark by measuring specific ratios of decay rates. Using current data we determine the ratio of form-factors in $Bs -> J/psi f0(980) with respect to Bz -> J/psi f_0(500) decays to be 0.99^{+0.13}_{-0.04} at a four-momentum transfer squared equal to the mass of the J/psi meson squared. In the case where these light mesons are considered to be quark-antiquark states, we give a determination of the mixing angle between strange and light quark states of less than 29 degrees at 90% confidence level. We also discuss the use of a similar ratio to investigate the structure of other isospin singlet states.

Quark and Lepton Flavor Physics / 119

Recent results on CP and T Violation in hadronic B-meson decays at BaBar

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We present the observation of Time-reversal asymmetry as well
as a selection of recent results on CP violation effects
in hadronic B-meson decays using the full data set collected at the peak of the Y(4S)
with the BABAR detector at SLAC. They include measurements of processes
sensitive to the angles of the Unitarity Triangle and studies of direct CP violation.

Quark and Lepton Flavor Physics / 87

Measurement of phi_s at LHCb

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The study of CP violation in Bs oscillations is one of the key goals of the LHCb experiment. Effects are predicted to be very small in the Standard Model but can be significantly enhanced in many models of new physics. We present the world's best measurement of the CP-violating phase φs using B0s → J/ψφ and B0s → J/ψππ decays.

Quark and Lepton Flavor Physics / 174

Lepton Flavour Violation in Extended Higgs Sectors

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With the discovery of a new boson with a mass around 125 GeV so far compatible with the standard model Higgs, a new era in the understanding of the electroweak symmetry breaking mechanism has started. Searches for lepton flavour violating (LFV) effects at the LHC associated to the Higgs sector offer an interesting possibility to test for new physics scenarios.
In this talk, we will consider general two-Higgs-doublet extensions of the Standard Model and explore the constraints from LFV searches at the B factories. Finally, we will discuss the prospects of such analyses at the LHC and at the next generation of flavour factories.

Quark and Lepton Flavor Physics / 171

Measurements of the properties of bottom baryons at CDF

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We report measurements of the masses and mean lifetimes for ground state b-baryons updated with the full Tevatron run II data set obtained by the CDF detector. The baryons are reconstructed in decay modes with a J/psi or Xi_c, namely Lambda_b --> J/psi Lambda, Xi_b^- --> J/psi Xi, Omega_b --> J/psi Omega, Xi_b^- --> Xi_c^0 pi^-, and Xi_b^0 --> Xi_c^- pi^+. These are legacy measurements for b-baryons from CDF.

Quark and Lepton Flavor Physics / 103

Searches for rare and forbidden kaon decays at the NA62 experiment at CERN

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The decay K+ -> pi+ nu nu-bar is highly suppressed in the Standard Model (SM), while its rate can be predicted with minimal theoretical uncertainty. The branching ratio for this decay is thus a sensitive probe of the flavor sector of the SM.; however, the smallness of this BR (8 x 10^-11) and challenging experimental signature make it very difficult to measure. The primary goal of the NA62 experiment at the CERN SPS is to measure BR(K+ -> pi+ nu nu-bar) with ~10% precision. This will require the observation of 10^13 K+ decays in the experiment's fiducial volume, as well as the use of high-performance systems for precision tracking, particle identification, and photon vetoing. These aspects of the experiment will also allow NA62 to carry out a rich program of searches for lepton flavor and/or number violating K+ decays. Such searches can probe new physics scenarios involving, for example, heavy Majorana neutrinos or R-parity violating SUSY. Part of the experimental apparatus was commissioned during a technical run in 2012; installation continues and data taking is expected to begin in late 2014. The physics prospects and the status of the NA62 experiment will be reviewed.

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KOTO experiment: searching for K_{L}->pi^{0} nu bar{nu}

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We are going to report on the performance of the K0TO experiment at J-PARC during the 2013 physics run. The goal of K0TO is to discover and measure the rate of the rare decay KL into pi0 nu nubar .
This flavor changing neutral current decay violates CP directly and proceeds through second-order weak interactions.
The Standard Model predicts the branching ratio to be (2.8+/-0.4)x10^(-11).
The experiment is designed to reach sensitivity for discovery of this rare decay with 2x10^(14) protons on target (POT) per spill in 3 Snowmass years (3x10^(7)s).
It is a follow-up to E391 at KEK with a completely redesigned beamline, a new CsI calorimeter with increased granularity and reduced shower leakage, and a new readout electronics, trigger and data acquisition system.
K0TO first physics run, scheduled for May-June 2013, expects to accumulate about 10^(19) protons on target（POT） and reach the Grossman-Nir limit sensitivity of 1.46x10^(-19) at 90% CL. However, due to one radiation accident occurred on May 23th, the data taking is stopped, and the integrated POT is 8*10^(18).

Quark and Lepton Flavor Physics / 106

Charming hadronic decays of b hadrons

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Vast data samples of b-hadron decays to final states that contain open charm particles have been collected by the B factories and LHCb. One area of use for these final states is the study of fundamental parameters in the Standard Model (SM), e.g., the CKM angle gamma. Open charm final states can be used to search for physics beyond the SM and also as a QCD laboratory. This talk will review recent results in this area and also discuss some exciting new areas where results are expected to be published in the near future.

Quark and Lepton Flavor Physics / 223

Leptonic and semileptonic decays at Belle

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We report Belle results on missing energy decays such as
B->tau nu, B->D* tau nu as well other recent results on
semileptonic decays (e.g. B->pi/rho l nu with tags)

Quark and Lepton Flavor Physics / 173

Measurements of charm mixing and CP asymmetries in CDF data

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The full CDF Run II data set, corresponding to an integrated luminosity of nearly 10 fb^-1 of proton-antiproton collisions at 1.96 TeV, is used to measure mixing and CP asymmetries in charm mesons. The large number of reconstructed charm decays are used to measure CP asymmetries are measured for a number of decay modes. Mixing of D0 and D0-bar mesons is observed with a significance corresponding to 6.1 Gaussian sigmas in the time-dependent ratio of decay rate for D0 -> K+ pi- to that for D0 -> K-pi+. The mixing parameters are measured to be R_D = (3.51 ± 0.35) 10^-3, x'^2 = (0.08 ± 0.18) 10^-3, and y' = (4.3 ± 4.3) 10^-3.

Quark and Lepton Flavor Physics / 222

CP Violation results from Belle

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We report Belle results on CP violation in b->u modes such as B->rho0 rho0 and B->pi+ pi- as well as in b->s modes including B^0-> omega K_S and eta' K_S.

Quark and Lepton Flavor Physics / 228

Results on New Particles from Belle

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We report recent Belle results
on new particles including observation of the
Z_c(3894), observation of a chi_c1 gamma resonance,
observation of the eta_b(1S), eta_b(2S), h_b and chi_b states
and determination of the quantum numbers of the Z(4430).

Quark and Lepton Flavor Physics / 227

Charm mixing and CP Violation at Belle

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We report results from Belle on charm mixing and CP violation:
the topics include A_CP(D^0->pi0 pi0),
D->K 3pi WS rate, CPV in Lambda_c, D mixing in D->h h,
and CPV in D->Ks K+.

Quark and Lepton Flavor Physics / 226

Results from Belle's Upsilon(5S) data sample

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We report results on new resonances and B_s physics from
Belle unique dataset at the Upsilon(5S) resonance. The results
include Z_b->B B^*, B^* B^*; Obervation of the
Upsilon(1D), Scan of Upsilon(nS) pi+pi-, B_s->J/psi K+K-,
B_s ->Ds h and related modes.

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Production and spectroscopy of hadrons containing b quark at ATLAS

Ms. WANG, Rui [1]; TOMS, Konstantin [1]; Prof. SEIDEL, Sally [1]

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We present a study of the B-hadron family production and spectroscopy. We reconstruct B ground states in the hadronic decay modes with a J/psi in the final state. Some relevant excited states are reconstructed through the hadronic transitions. This study is based on 4.8fb^-1 2011 7TeV and 19.2fb^-1 2012 8TeV datasets collected by the ATLAS detector.

Quark and Lepton Flavor Physics / 95

Latest D Meson Hadronic Branching Fractions from CLEO

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The branching fractions of the decays $D^0 \to K^- \pi^+$, $D^+ \to K^- \pi^+ \pi^+$, and $D_s \to K^- K^+ \pi^+$ normalize many measurements of processes involving charm quarks. In addition hadronic D decays probe the interaction of short-distance weak processes and long-distance QCD effects. We report results on three D^0, six D^+, and thirteen D_s branching fractions obtained using the full CLEO-c datasets of 818 pb^{-1} at 3.77 GeV and 586 pb^${-1}$ at 4.17 GeV.

Quark and Lepton Flavor Physics / 225

Hadronic B Decays from Belle

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We report new results on hadronic B decays including
the B->pi0 pi0 BF and asym and B->phi (K pi) BF's,
angular correlations and asymmetries
as well as other related modes.

Quark and Lepton Flavor Physics / 36

ORKA: The Golden Kaon Experiment

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Precision measurement of the ultra-rare $K^+\to\pi^+\nu \bar\nu$ decay at Fermilab would be one of the most incisive probes of quark flavor physics this decade. Its dramatic reach for uncovering new physics is due to several important factors: The branching ratio is sensitive to most new physics models which extend the Standard Model to solve its considerable problems. The Standard Model prediction for BR($K^+\to\pi^+\nu \bar\nu$) is broadly recognized to be theoretically robust at the 5--10\% level. Only a precious few accessible loop-dominated quark processes can be predicted with this level of certainty. The $K^+\to\pi^+\nu \bar\nu$ branching ratio is highly suppressed in the Standard Model to the level of $< 10^{-10}$ (<1 part in 10 billion). This suppression allows physics beyond the Standard Model to boost the branching fraction with enhancements of up to a factor of five above the Standard Model level. The certainty with which the Standard Model contribution to $K^+\to\pi^+\nu \bar\nu$ can be predicted will permit a 5$\sigmA$ discovery potential for new physics even for enhancements of the branching ratio as small as 35\%. This sensitivity is unique in quark flavor physics and allows probing of essentially all models of new physics that couple to quarks within the reach of the LHC. Furthermore, a high precision measurement of $K^+\to\pi^+\nu \bar\nu$ is sensitive to many models of new physics with mass scales well beyond the direct reach of the LHC. The ORKA initiative aims to precisely measure the $K^+\to\pi^+\nu \bar\nu$ process based on established detector techniques driven with the Fermilab Main Injector high intensity proton source. In recognition of this exciting opportunity the Fermilab director has recently granted scientific approval to the ORKA proposal. The physics reach and experimental techniques of the ORKA initiative will be discussed, as well as opportunities for collaboration in the ORKA adventure and the longer term Intensity Frontier roadmap at Fermilab.

Quark and Lepton Flavor Physics / 235

CP Violation measurements with the D0 experiment

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We present results of the measurements of CP-violating parameters for a variety of b hadron species using the full Run 2 data set collected by the D0 detector. These include a new analysis testing for direct CP violation in B+ decays, in addition to specific semileptonic charge asymmetries of B0s and B0 decays testing for CP violation in mixing.

Quark and Lepton Flavor Physics / 233

Theoretical issues in flavor physics

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Quark and lepton flavor physics presents us with a basic question: Can we understand the pattern of masses and mixings of the known quarks and leptons, and how do present and proposed measurements help to advance that goal? Topics to be discussed include the apparent suppression of new flavor-changing effects, the status of quark and lepton mixing, the implications of new measurements of CP asymmetries in heavy quark decays, the impications of forthcoming experiments on the muon's g-2 and its transitions to an electron, and what we can hope to learn from electric dipole moments.

Quark and Lepton Flavor Physics / 224

Measurements of Electroweak Penguins at Belle

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Recent measurements of exclusive and inclusive B->X_s l+ l- and b->s gamma decays are reported from Belle.

Quark and Lepton Flavor Physics / 46

Studies of asymmetries in semileptonic B decays at LHCb

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LHCb has recorded large samples of semileptonic B decays. These provide potential to study CP violation effects in the B0 and Bs0 systems. Decay time-integrated or time-dependent asymmetries between charge-conjugate final states probe CP violation in B(s)0 mixing through the measurement of the parameter Afs (sometimes referred to as Asl). These measurements rely on data-driven techniques to obtain excellent control of systematic uncertainties. We present the status of the analyses.

Quark and Lepton Flavor Physics / 44

Searches for rare decays at LHCb

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Rare decays of beauty and charm hadrons and lepton flavour/number violating decays of tau leptons test the flavour structure of the underlying theory at the level of quantum corrections. They provide information on the couplings and masses of heavy virtual particles appearing as intermediate states. A review of recent results obtained by LHCb on these topics will be presented.

Quark and Lepton Flavor Physics / 45

Measurements of B → DK decays to constrain the CKM unitarity triangle angle γ at LHCb

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The angle γ of the CKM unitarity triangle remains the least precisely measured parameter of the CKM mixing matrix. The precision measurement of this parameter is one of the main goals of the LHCb experiment. We present a wide range of measurements of CP violation and partial rates in B→DK decays, as well as the latest LHCb measurement of γ combining all the individual inputs.

Quark and Lepton Flavor Physics / 43

Studies of hadronic B decays to open charm mesons at LHCb

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LHCb has collected unprecedented large samples of B hadron decays to final states involving charmed hadrons. These decays offer many complementary measurements of CP violation and CKM matrix parameters, and serve as a laboratory for testing effective theories of hadron decays. We present a selection of new world leading results in these types of decays, including first observations of new decay modes, world best branching ratio measurements and studies of resonant structures.

Quark and Lepton Flavor Physics / 204

Flavor Physics and Lattice QCD

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Our ability to resolve new physics effects is, largely, limited by the precision with which we calculate. The calculation of observables in the Standard (or a new physics) Model requires knowledge of the associated hadronic contributions. The precision of such calculations, and therefore our ability to leverage experiment, is typically limited by hadronic uncertainties. The only first-principles method for calculating the nonperturbative, hadronic contributions is lattice QCD. Modern lattice calculations have controlled errors, are systematically improvable, and - in some cases - are pushing the sub-percent level of precision. I'll outline the role lattice plays in flavor physics, highlight state of the art lattice efforts, and discuss the future of lattice calculations.

Quark and Lepton Flavor Physics / 140

New Physics in B->D^(*) \tau nu_tau Decays

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We perform a comprehensive study of the impact of new-physics operators with different Lorentz structures on $\bar{B} -> D^{(*)} l^- \bar{\nu}_l$ decays, $\ell = e^-, \mu^-, \tau^- $, involving the $b \to c l \nu_\ell$ transition. We present the full three angle and q^2 angular distribution with new physics operators with complex couplings. Various observables are constructed from the angular distribution including the CP violating triple product asymmetries which vanish in the Standard Model without any hadronic complications.

Quark and Lepton Flavor Physics / 148

Review of charmless three-body decays of b-hadrons

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To test for physics beyond the Standard Model it is vitally important to make precise measurements of direct and mixing-induced CP-violating observables in as many different quark-level transitions as possible. Charmless three-body B decays provide an excellent laboratory in which to make such measurements in loop-dominated decays. Extra sensitivity can also be gained from performing amplitude analyses, which allow measurements of the relative phases of the intermediate processes as well as their magnitudes.

We present a review of recent results from studies of charmless 3-body
decays of b-hadrons, including direct CP violation measurements in charged B decays and the first measurements of Lambda_b decays to such final states.

Top Quark Physics / 213

Up Sector of Minimal Flavor Violation: Top Quark Properties and Direct D meson CP violation

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Minimal Flavor Violation in the up-type quark sector leads to particularly interesting phenomenology due to the interplay of flavor physics in the charm sector and collider physics from flavor changing processes in the top sector. We study the most general operators that can affect top quark properties and D meson decays in this scenario, concentrating on two CP violating operators for detailed studies. The consequences of these effective operators on charm and top flavor changing processes are generically small, but can be enhanced if there exists a light flavor mediator that is a Standard Model gauge singlet scalar and transforms under the flavor symmetry group. This flavor mediator can satisfy the current experimental bounds with a mass as low as tens of GeV and explain observed D-meson direct CP violation. Additionally, the model predicts a non-trivial branching fraction for a top quark decay that would mimic a dijet resonance.

Top Quark Physics / 130

A Search for $t\bar{t}$ Resonances in Lepton Plus Jets Events with ATLAS using 14 fb^{-1} of Proton-Proton Collisions at $\sqrt{s}$ = 8 TeV

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Some Beyond the Standard Model theories predict new particles that decay predominantly into top-antitop quark pairs. A search for top-antitop quark resonances that decay into the lepton plus jets final state is carried out with the ATLAS experiment at the LHC using 14 fb^{-1} of $\sqrt{s}$ = 8 TeV proton-proton collisions. The search considers both cases where all of the final state jets are isolated and where some or all of the top quark decay products are merged into a single jet. Mass exclusion limits at a 95\% credibility level are set for two benchmark models, one predicting leptophobic topcolor Z' bosons and the other predicting Randall-Sundrum Kaluza-Klein gluons.

Top Quark Physics / 101

FCNC Top Quark Production Via Anomalous Couplings

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We calculate flavor-changing neutral current (FCNC) processes with top-quark production via anomalous couplings at 7, 8, and 14 TeV. We update progress on the FCNC processes $pp \to tZ$, $pp \to t \gamma$ and $pp \to tg$. We go beyond leading order and include soft-gluon corrections through next-to-next-to-leading order.

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Top quark transverse momentum and rapidity distributions

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I present NNLO approximate calculations, based on NNLL resummation, for top quark differential transverse momentum and rapidity distributions. In particular recent results are presented for top-pair production and single-top production processes and compared to the latest experimental data from the LHC.

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Search for ttbar resonances in semileptonic final states in pp collisions at sqrt(s) = 8 TeV

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We present a search for the production of heavy resonances decaying into top-antitop quark pairs at the CMS Experiment. The data correspond to an integrated luminosity of 19.6 fb^-1 at sqrt(s) = 8 TeV. We consider all events containing one muon or electron and at least two jets in the final state. We present results from the combination of two dedicated searches, the first optimized for ttbar production at the kinematic production threshold, and the other optimized for ttbar production produced with high Lorentz boosts. We do not observe any excess of events above the expected yield from the standard model processes. We set the following limits at 95% CL on the production of non-SM particles: top color Z' bosons with relative widths of 1.2% and 10% are excluded for masses below 2.1 TeV and 2.7 TeV. An upper limit of 1.94 pb and 0.029 pb is set on the production cross section times branching fraction for narrow resonances with masses of 0.5 TeV and 2 TeV. Likewise, limits of 1.71 pb and 0.045 pb are set for wide resonances with masses of 0.5 TeV and 2 TeV. In addition, Kaluza–Klein excitations of a gluon with masses below 2.5 TeV in the Randall–Sundrum model are excluded and an upper limit of 0.101 pb is set for a resonance mass of 2 TeV.

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Spin Correlations of Top Quarks at D0

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We present results of a measurement of the ratio of events with correlated top quark spins to the total number of top quark events. The measurement is using 9.7 fb^-1 of data collected with the D0 detector at the Tevatron proton-antiproton collider. The fraction of events with top spin correlation is measured by employing a Matrix Element method providing increased sensitivity. Results are compared to the SM prediction.

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First measurement of single top production in the tW-channel in pp collisions

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We present the first measurement of single top quark production in the tW-channel in pp collisions, in which a top quark is produced in association with a W boson. The data are collected with the CMS detector at center-of-mass energies of 7 TeV and 8 TeV. The experimental signature is similar to top pair production, and there is interference at higher orders between the two processes. The measurement is perfomed using final states in which the associated W boson as well as the one originating from the top quark decay leptonically. Multivariate methods are used to extract the cross section. The result is compared with current standard model theory predictions.

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Measurement of s-channel single-top-quark production in lepton+jets at CDF

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We report a measurement of the single-top-quark production cross section in the lepton+jets channel using 9.45/fb of $p\bar{p}$ collision data collected by the Collider Detector at Fermilab at 1.96 TeV center-of-mass energy. Candidate events are classified as signal-like by a neural network discriminant. Measurements of s-channel production are particularly interesting at the Tevatron since this production channel has yet to be definitively observed and it is very difficult to study at the Large Hadron Collider. We show, for the first time publicly, results of an analysis optimized to study s-channel single-top-quark production using the full CDF dataset.

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Measurement of s-channel single-top-quark production in MET+jets at CDF

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We report a measurement of the single-top-quark production cross section with the full dataset collected by the Collider Detector at Fermilab in $p\bar{p}$ collisions at a center-of-mass energy of 1.96. The events are selected requiring large missing transverse energy, two or more high Pt jets and no leptons in the final state. Multivariate techniques are implemented to suppress the contribution from QCD multijet production and discriminate single-top signal from the remaining background. The measurement of s-channel production is particularly important at the Tevatron since the low cross section at the LHC makes this still unobserved channel very hard to see. Results from an optimized s-channel analysis, performed for the first time in the MET+jets final state, are shown.

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Search for W' production in the single top channel with the ATLAS detector

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We present the search for W' -> tb using the LHC pp collision data collected with the ATLAS detector at a center-of- mass energy of 8 TeV. The primary backgrounds to this search are ttbar, W+jets, and multijets processes. To reduce the contributions of these backgrounds we require a leptonic final state and use Boosted Decision Trees to discriminate against background-like events. This measurement gives the latest limits on the W' -> tb cross section times branching ratio and the ratio of coupling constants g'/g as functions of the W' mass.

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Lunchtime discussion on gender bias

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Young Physicists' Forum